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The Siricidæ of North America

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Over ten years ago the writer undertook to rearrange the collection of Siricidæ and allied families belonging to Mr. E. T. Cresson, then in the keeping of the American Entomological Society, and which since then has been most generously presented to that society by Mr. Cresson. Since that time, during the intervals of other duties, these insects have received a greater or less degree of attention at his hands, and the paper then begun has been several times rewritten and extended.

Unable to foresee the early completion and publication of the entire work, and confronted with the expressed desire of certain workers in the field of Hymenopterology that it should be available to them at an early date, it has seemed best to present a preliminary and brief account.

Pending the completion and publication of the fuller work, which is planned to cover the families Siricidæ, Cephidæ, Megalodontidæ, Oryssidæ, and Xiphydriidæ, the author will be grateful for the correction of errors, discrepancies or omissions in the present paper, and especially for the loan of material in any of the above groups, from any part of the world, which he will be glad to identify.

Acknowledgments are due to Professors J. H. Comstock, A. D. MacGillivray, the late Dr. William H. Ashmead, Mr. S. A. Rohwer, Dr. L. O. Howard, and others, which will be expressed in more detail when the fuller paper is published. I am indebted to my brother, Dr. B. W. Bradley, for assistance in the determination of the derivation and grammatical form of the technical names.

Mr. S. A. Rohwer (1911b) has had the last word upon the classification of the horn-tails and sawflies (Chalastogastra). While recognizing the weight of his views as therein expressed, I have not been able in all cases to accept them. In my opinion

there have been two well-marked lines in the phylogeny of the suborder, the Tenthredinid and the Siricid stems. The Xyelidæ and Pamphiliidæ are very primitive forms that represent offshoots from near where these two stems divide. The Siricidæ also retain many highly primitive characters, although in other respects "sidewise specialized". The Xiphydriidæ, Cephidæ, and Megalodontidæ group themselves with them. The Oryssidæ represent the most highly modified group within the suborder. They are more divergent from any other family than are any of the other families from each other. Yet I believe they had an ancestry somewhere along the Siricid stem. I am not convinced of the taxonomic advisability of erecting super-families for small groups of their nature, representing as they do, highly specialized offshoots of some other stock.

The classification offered by Dr. MacGillivray (1906) was based upon careful and critical comparative study of a single set of organs—the wings, and seems more conservative and more in accordance with my own views. I have followed, in the main, the arrangement which he proposes.

I am not prepared, from personal knowledge, to offer an opinion upon the advisability of dividing the Tenthredinidæ into several families, as is done by Ashmead and Rohwer. It is outside of the scope of this paper, and I have followed Dr. MacGillivray's classification in this regard.

THE SUBORDER CHALASTOGASTRA

A Key to the Families

A. Front wings with R_2 present, possessing three marginal cells. *XYELIDÆ*

AA. Front wings with R_2 absent, therefore possessing one or two but never three marginal cells.

B. Front wings with subcosta present as a distinct longitudinal vein. *PAMPHILIIDÆ*

BB. Front wings with subcosta absent. (Rarely it is present as a pale, very indistinct line, closely appressed to R + M, or Sc_1 may be present as a transverse vein).

C. The radial cross-vein in the front wings with its caudal end basad of R_5, or if it or R_5 is absent or they are opposite then the anterior tibiæ have a single apical spur.

D. Front wings with M_2 complete; ovipositor more or less saw-like, usually exserted and with prominent sheaths; antennæ not inserted beneath a frontal ridge.

E. Anterior tibiæ each with only one apical spur; propodeum divided longitudinally.

F. Pronotum presenting a strictly cephalic surface, or both cephalic and dorsal surfaces; front wings with the medio-cubital cross-vein subequal in length to the transverse part of media. (Fig. 6.)

G. Pronotum transversely r i g h t-angled, so that it presents both a strictly dorsal and a cephalic aspect, the latter concave; mesopræscutum poorly defined or wanting; Sc_1 absent; maxillary palpi one-segmented; labial palpi two or three-segmented, the last segment enlarged and bearing a large sensory cup, the first segment not elongate. (Figs. 16 and 17.) *SIRICIDÆ*

GG. Pronotum a narrow collar extending around the front of the thorax, therefore presenting lateral and cephalic but no dorsal aspect; mesopræscutum well developed; Sc_1 present in the front wings as a transverse vein; maxillary palpi four-segmented; labial palpi three-segmented, the first segment elongate. *XIPHYDRIIDÆ*

FF. Pronotum more or less quadrate, not transversely angled, presenting lateral and dorsal but no strictly cephalic surfaces, its posterior margin extending almost directly from

tegula to tegula; mesopræscutum well defined; front wings with the medio-cubital cross-vein never less than three and sometimes four or five times the length of the transverse part of media. *CEPHIDÆ*

EE. Anterior tibiæ each with two apical spurs; propodeum not divided longitudinally but broadly emarginate behind. *MEGALODONTIDÆ* (*European*)

DD. Front wings with the transverse part of M_2 absent; ovipositor retractile, thread-like, without prominent sheaths; antennæ inserted low on the front beneath a prominent ridge which has the appearance of being the clypeus; vertex with a crown of tubercles; propodeum not divided longitudinally. *ORYSSIDÆ*

CC. The radial cross-vein in the front wings with its caudal end distinctly apicad of R_2, or wanting; the anterior tibiæ with two apical spurs.

D. Antennæ four-segmented, the third segment about twice as long as the first two united, and about nine times as long as the fourth. *BLASTICOTOMIDÆ*

DD. Antennæ variously formed, but not as above. *TENTHREDINIDÆ*

THE FAMILY SIRICIDÆ

History of the Nomenclature of the Genera

There have long been recognized five groups, corresponding to what we now call genera, although not all of them, until within the past fifteen years, have been recognized as genera.

Linnæus in the tenth edition of the Systema naturæ grouped together under the comprehensive genus Ichneumon the species for which he subsequently erected the genus Sirex (1761). These were five in number, and include the types of three of the genera today recognized, as well as one belonging to another family. These originally included species of Sirex were: *gigas, spectrum, juvencus, camelus,* and *marisca.*

The following year Geoffroy proposed the name Urocerus, figuring and indicating by a direct bibliographical reference

only the species which had been described by Linnæus (1758) as *Ichneumon gigas,* and which Linnæus had subsequently placed in Sirex. That he had done so, however, was unknown to Geoffroy, whose conception of Urocerus was doubtless equivalent to that of Sirex by Linnæus. While Geoffroy does not *name* any species of Urocerus, he describes one and only one, and by a definite bibliographical reference and a figure identifies it with *Ichneumon gigas* of Linnæus. The genus Urocerus is therefore monobasic, with *Ichneumon gigas* as type. This interpretation is confirmed by Latreille who in 1810 definitely designed *gigas* as type. Fourcroy (1875) was the first to actually use a specific name in association with Urocerus, *gigas* being the name of the species that he then included. From that time until the end of the nineteenth century authors have used, some Sirex, others Urocerus, but always with the same meaning. During the past fifteen years, as a result of the work of Ashmead and Konow, Sirex has been generally recognized as the correct name and Urocerus as a synonym, and this is the status indicated by Rohwer (1911a).

It had long been recognized that there were three species—groups within the old genus Sirex (excluding Tremex, which will be mentioned later), one containing *gigas* and its allies, another *juvencus* and its allies, and the third *spectrum* and its allies. For the latter Costa (1895) proposed the subgeneric name Xeris and Konow (1896) for the *juvencus* group the subgeneric name Paururus. These were shortly, and very appropriately, raised to generic rank. Xeris contained the single species *spectrum* which is therefore its type. The type of Paururus is *juvencus* by designation of Rohwer (1911a). Sirex as thus restricted in the sense of Konow, Ashmead, and Rohwer was with the supposition voiced by Rohwer (1911a) that *gigas* was its type.

That, then, up to the present is the status of the old genus Sirex,——*gigas* and its allies retained in it, *juvencus* and allies placed in Paururus, *spectrum* and allies in Xeris.

But unfortunately Curtis (1829) definitely designated *juvencus* as the type of Sirex, a fact known to Rohwer, and over-

looked by him in fixing *gigas* as type only through a clerical error. Paururus having the same type is therefore a synonym of Sirex, and the old name Urocerus, long considered a synonym of Sirex but having in reality a different type, namely *gigas,* must be resurrected for Sirex in the sense of recent authors.

The present genera then will be:

SIREX, type *juvencus* (=Paururus, Konow, Ashmead, and Rohwer).

UROCERUS, type *gigas* (= Sirex of Konow, Ashmead, and Rohwer).

XERIS, type *spectrum.*

Jurine (1807) erected the genus Tremex for *Sirex magus* and *S. fuscicornis* F. Latreille (1810) indicated the latter as type of the genus. *Xyloterus* Hartig (1837) (not Erichson 1836) and Xylœcematium Heyden (1868) (*n. n.* for Xyloterus) both have *fuscicornis* for their types and are synonyms of Tremex. These names have been but rarely used.

Norton (1869) proposed the name Teredon for *Tremex latitarsis* and *T. cubensis* Cresson. Kirby (1882) proposed Teredonia to replace Teredon on the mistaken conclusion that the latter was preoccupied. Teredon, however, is a valid name.

The Taxonomy of the Genera

Ashmead (1898) recognizes two subfamilies, Siricinæ and Tremecinæ, allying Xeris with Tremex and Teredon in the latter. That is an unnatural alignment, brought about by the unfortunate selection of characters which he used in separating the subfamilies. The first of these is the variation in the caudal end of r-m in the front wings which may be upon the longitudinal or again upon the transverse part of media. But we find the same variation within single species; it is in fact a character upon which no reliance can be placed in the Siricidæ. The second character is the presence of one or two apical spurs on the posterior tibiæ. Konow (1905) recognizing Siricidæ in the present sense as a subfamily, divides it into two tribes, corresponding exactly to the divisions employed by Ashmead.

Rohwer (1911b) attains a more natural arrangement by placing Xeris in the Siricinæ. His arrangement is as follows:

"Antennæ long and slender, basal vein received near the middle of the first discoidal cell; second transverse cubitus present. *Sirecinae*

"Hind tibiæ with two calcaria; humerus [2d A] and transverse median of the hind wings present. *Sirecini*

"Hind tibiæ with one calcaria [sic (!)]; humerus [2d A] and transverse median of the hind wings wanting. *Xeriini*

"Antennæ short and stout; basal vein and transverse median interstitial, or nearly so; second transverse cubitus wanting. *Tremecinae*"

The basal vein (Fig. 8*b*) is m-cu, and the first discoidal cell in the sense of Cresson, Marlatt, and others, M_1, which, of course, can not receive m-cu. Evidently Rohwer means here, cell Cu_1. Examining the several figures of wings here presented (Figs. 6-11) it will be noted that on this character the wing of Xeris would fall doubtfully into the Tremicinæ and the wing of Teredon clearly into Siricinæ, resembling closely in this respect the wing of *Urocerus flavicornis*. The second transverse cubitus (Fig. 8*tc*^{2}) is R_5, and this is frequently, probably normally, present in Teredon, which would thereby fall into the Siricinæ.

There are, however, two important characters which all authors have overlooked in differentiating the subfamilies. Sirex, Urocerus, and Xeris have 3-segmented labial palpi (Figs. 4, 5, and 17), and retain the cerci. Tremex and presumably Teredon (although lack of material makes verification impossible) possess 2-segmented labial palpi (Fig. 16) and have lost the cerci.

A further discussion of the relations of the genera would occupy too much space, and I shall reserve it until a later date.

The Forms of the Names

Under each genus I have indicated its derivation, gender, and stem to be used for derivatives. The following forms are the proper ones: Siricini, Siricinæ, and Siricidæ, not, as has some-

times been written, Sirecini, Sirecinæ, and Sirecidæ; Tremicini and Tremicinæ, not Tremecini and Tremecinæ; and Xerini, not Xeriini.

A Key to the Subfamilies and Genera of Siricidæ

A. Labial palpi 3-segmented (Fig. 17); cerci present; antennæ filiform, seventeen- to twenty-five-segmented (Figs. 37 and 39); the radial cross-vein in the front wings received in the cell R_5 but never near its apex; posterior tibiæ with one or two apical spurs. Siricinae

B. Cornus of the female shouldered or not (Figs. 18-25), but never constricted at the base and then widened apically; free part of Cu_2 usually distinct; head immaculate; posterior tibiæ with two apical spurs. *Sirex* Linnæus

BB. Cornus of the female constricted at base and widened apically (Figs. 26-33); never more than a stump of the free part of Cu_2 present; a white spot present behind the eye.

C. Posterior tibiæ with two apical spurs; ovipositor shorter than the abdomen. *Urocerus* Geoffroy

CC. Posterior tibiæ with one apical spur; ovipositor usually much longer than the abdomen. *Xeris* Costa

AA. Labial palpi 2-segmented, very thick (Fig. 16); cerci absent; antennæ short, four- to fourteen-segmented, or in a few oriental species as many as twenty-segmented, somewhat thickened in the middle; R_5 in the front wings absent, the radial cross-vein therefore received in the united cells R_4+_5 or if R_5 is present (Figs. 9 and 10), then the radial cross-vein is directly opposite it; posterior tibiæ with one apical spur. Tremicinae

B. In the front wings R_5 is lost (Fig. 9); posterior legs flattened in both sexes, but not greatly dilated; flagellum with fourteen or more segments. *Tremex* Jurine

BB. In the front wings R_5 normally retained (Fig. 10); posterior legs flattened, the tibiæ and tarsi greatly dilated (Figs. 12 and 13); flagellum reduced to three segments. *Teredon* Norton (Cuban)

Sirex Linnæus

Sirex, *gen.* siricis, M. <σειρήν= a wasp (Aristotle) *derivatives*: siric +

(Figs. 1, 6, 15, 17, 18-25, 37, and 39)

<1758 *Ichneumon* Linnæus. Syst. nat.; ed. 10, v. 1: p. 560.
1761 *Sirex* Linnæus. Fauna suec.; ed. 2: p. 396.

1762 *Urocerus* Geoffroy. Hist. abreg. insec. de Paris; v. 2: p. 264.
1896 *Paururus* Konow *subgenus*. Verschied. aus der Hym.-Gruppe d. Tenthred. < Wien. ent. Zeit; v. 15: p. 41.

The type of the genus is *Sirex juvencus* Linnæus, by designation of Curtis (1829). The type of Paururus Konow is the same (*vide* Rohwer, 1911a) and the latter is therefore a synonym of Sirex.

The females of this genus are readily distinguished from those of other genera by the shape of the cornus. Both sexes are distinguished by the absence of white marks on the cheeks, which I have found a thoroughly constant character. It is the hardest of all genera in which to separate the males from each other. Confusion has existed among them, and to some extent continues.

A Key to the North American Species of Sirex.

FEMALES

A. Abdomen blue.

B. Legs black or blue, except sometimes apical half of posterior tarsi.

C. Cornus short and triangular or shouldered.

D. From a side view the cornus is arched and distinctly widened before the apex, from above short and triangular (Figs. 18 and 19).
californicus (Ashmead)

DD. From a side view the cornus is not arched, tapering or at least scarcely widened before the apex, from above short and shouldered (Figs. 20 and 21).

E. In the front wings M_2 separating from M_1 midway between R_4 and R_5; wings dark violaceous, especially at the base and along the costal margin; body short and stout, the thorax very broad; second segment of the posterior tarsus shorter than the two following united; impressed basin on the abdomen in front of the cornus deep and wider than long.
obesus n. sp.

EE. In the front wings M_2 separating from M_1; much closer to R_5 than to R_4; wings varying from slightly smoky to almost violaceous; body as in *cyaneus* and other species; the thorax not exceptionally broad; second segment of the posterior tarsus longer than the two following united; impressed basin in front of the cornus shallow, and as long or longer than wide. *edwardsii* Brullé

CC. Cornus elongate, not shouldered, a ridge at each side towards the base (Fig. 22). *areolatus* (Cresson) Kirby

BB. Legs except coxæ yellow or reddish yellow. [Wings nearly hyaline, or somewhat infuscated, especially along the outer margin; cornus shorter than in *areolatus,* but distinctly longer than in *edwardsii,* not shouldered, from a lateral view usually somewhat arched and widened before the apex (Fig. 23).] *juvencus* race *cyaneus* Fabricius

AA. Abdomen more or less red.

B. Wings hyaline, with a transverse fuscous band basad of the stigma, and a fuscous apical margin; cornus scarcely shouldered (Fig. 25); only two basal segments of abdomen red. *behrensii* (Cresson) Kirby

BB. Wings fuliginous; cornus distinctly shouldered (Fig. 24); basal three or four abdominal segments blue-black. *nigricornis* Fabricius

MALES

A. Head and thorax metallic green; posterior or sometimes all the legs except their coxæ rufous; abdomen except basal one or two segments red. [Wings yellow, especially at base.] *areolatus* (Cresson) Kirby

AA. Head and thorax black or blue-black, or if somewhat green, the body and legs not colored as above.

B. Apical segment of abdomen blue or black.

C. Seventh dorsal abdominal segment blue or black.

D. Only the fifth and sixth dorsal abdominal segments yellow; legs brown except the anterior and middle femora at tips, their tibiæ and tarsi, the posterior knees and last two tarsal segments reddish yellow; wings yellowish, smoky around the outer margins; antennæ black. *edwardsii* Brullé

DD. The fourth and apical half of the third dorsal abdominal segments, as well as the fifth and sixth, yellow; legs rufous, the hind tibiæ and first three segments of the tarsi black; wings yellowish, hyaline; apices of the first two antennal segments rufous beneath.

abbotii Kirby

CC. Seventh dorsal abdominal segment red. [Legs entirely black; wings hyaline, veins brown.]

apicalis Kirby

BB. Apical segment of the abdomen red or yellow.

C. Posterior legs brown except the coxæ, second segment of the trochanters and last two tarsal segments red; wings hyaline, slightly yellow, no smoky band around the margin; veins yellowish brown. [Abdomen distinctly widened at the apex; thorax metallic, either blue or greenish; base of antennæ black.]

juvencus race *cyaneus* Fabricius

CC. Posterior legs brown or blue-black, except sometimes the knees, tibiæ and tarsi red; wings yellowish, with a distinct smoky outer border. *nigricornis* Fabricius

CCC. Posterior legs reddish brown except the coxæ which are black; wings hyaline, a little smoky at the tip. [Thorax not metallic, black, base of antennæ red.]

behrensii (Cresson) Kirby

Sirex californicus (Ashmead)

(Figs. 18 and 19)

1904 *Paururus californicus* Ashmead, ♀. Descr. of four new horn-tails. <Can. ent.; v. 36: p. 64.

Distribution: Inhabits the Pacific Coast, from northern California to British Columbia.

Sirex edwardsii Brulle

(Figs. 20 and 21)

1846 *Sirex edwardsii* Brullé, ♀. Hist. nat. d. ins. Hym.; v. 4: p. 645; pl. 45, f. 1.
1869 *Urocerus zonatus* Norton, ♂. Cat. descr. Tenthred. and Uroceridæ N. A. < Trans. Amer. ent. soc.; v. 2: p. 357.
1874 *Sirex abaddon* Westwood, ♀. Thes. ent. oxon.; p. 115; pl. 21, f. 7.
1874 *Sirex fulvocinctus* Westwood, ♀. *Loc. cit.*; p. 114; pl. 21, f. 1.
1904 *Paururus hopkinsi* Ashmead, ♂ ♀. Descr. of four new horn-tails. <Can. ent.; v. 36: p. 64.

Distribution: Inhabits the transition zone of the Atlantic States.

Sirex apicalis Kirby

1882 *Sirex apicalis* Kirby, ♂. List Hym. Brit. mus.; v. 1: p. 377; pl. 15, f. 11.

1898 *Paururus areolatus* Konow, ♂ ♀. Syst. und krit. Bearbeitung der Siricini. < Wien. ent. Zeit.; v. 17: p. 81.

I have seen a single specimen from unknown locality. *S. obesus* may be the female of this.

Distribution: Vancouver Island.

Sirex obesus new species

♀. ## Metallic blue-black, duller on abdomen. Wings dark violaceous, especially at base and the costal margin. Body short and stout, the thorax exceptionally broad, distinctly wider than the head.

Head and thorax clothed with sparse black pubescence; clypeus longitudinally striate; genæ closely and coarsely punctured; vertex with a distinct longitudinal prominence on each side above, these sparingly punctured and shining, rest of vertex coarsely closely punctured, almost rugose in places; antennæ short, 18 mm., 19-segmented, the apical segments with flattened surfaces, a longitudinal channel on the inner surface of each segment; thorax coarsely punctured, the shoulders tuberculate; mesoscutum mesally in front nearly impunctate and shining.

M_1 separating from M_2 midway between R_4 and R_5 in front wings. Legs rather short, stouter than in *edwardsii* and more spinose; the second tarsal segment shorter than the two following united; the claw with a strong tooth beneath and a lobe at base.

Basal plates and to some extent the second segment pubescent; the second and remaining dorsal segments minutely shagreened, opaque, the eighth toward the apex with punctures bearing short hairs; the precornal basin deep, broader than long, without a central carina, separated from the cornus by a suture; the upper surface of the cornus making an obtuse angle with the dorsal surface of the ninth segment; the base of the cornus considerably narrower than the ninth segment; cornus

from above of moderate length (3.5 mm.); strongly shouldered, beyond the shoulders serrate, the apical spine narrow; from a side view the dorsal surface is flat, the ventral surface tapering to the tip, except just beyond the anus two or three large serrations cause a slight widening; ovipositor extending less than 3 mm. beyond the tip of the cornus.

Length of thorax including basal plates 9 mm.; of abdomen 14.5 mm.; expanse of wings 54 mm.; antennæ 18 mm.; front wing 24.5 mm.; posterior leg 20 mm.; tibia 8 mm.; metatarsus 4 mm.; ovipositor 7 mm.; total length to tip of cornus 28 mm.

This may be the female of *apicalis*.

Habitat: Arizona.

Type: A unique female in the collection of the American Entomological Society.

Sirex abbotii Kirby

1882 *Sirex abbotii* Kirby, ♂. List Hym. Brit. mus.; v. 1: p. 378; pl. 15, f. 8.

1898 *Paururus cyaneus* Konow, ♂ ♀. Syst. und krit. Bearbeitung der Siricini. < Wein. ent. Zeit.; v. 17: p. 81.

This species is known with certainty only from the male. Female specimens from the same locality were recorded by Kirby as *S. edwardsii,* with the remarks that they were perhaps the females of *abbotii.* Konow is wrong in assigning this species to *cyaneus,* which does not occur south of New York, and is different in coloration. I have not seen specimens.

Distribution: Georgia.

Sirex areolatus (Cresson) Kirby

The abdomen of the female is a more metallic and shining blue than in the foregoing species.

Konow considers *apicalis* as a synonym of this species, but the male described by him for *areolatus* is not what I consider to be the male of *areolatus,* described below.

Westwood's figure, by the shape of the abdomen and cornus leaves no doubt but that his *gracilis* belongs here.

Caeruleus is at most a variety of *areolatus*. It differs only by having the posterior tarsi beyond the middle of the metatarsus red, darker on the last segment, and by having only slightly fuscous wings. *Edwardsii* shows quite as much variation in wing color.

KEY TO THE RACES OF SIREX AREOLATUS

Wings dark violaceous; legs entirely black or blue-black.
Race *areolatus* (Cresson) Kirby
Wings only slightly smoky; posterior tarsi beyond the middle of the metatarsus red, apical segment darker.
Race *caeruleus* (Cresson) Kirby

Race *areolatus* (Cresson) Kirby

(Fig. 22)

1867 *Urocerus arcolatus* Cresson, ♀. Cat. of a small coll. Hym. made in N. Mex. < Trans. Amer. ent. soc.; v. 1; p. 375.
1874 *Sirex gracilis* Westwood, ♀. Thes. ent. oxon.; p. 114; pl. 21, f. 4.

Known from the mountains of Arizona and New Mexico, Colorado and Northern California.

Race *caeruleus* (Cresson) Kirby

1880 *Urocerus caeruleus* Cresson, ♀. Descr. of new N. A. Hym. in coll. Am. Ent. Soc. < Trans. Amer. ent. soc.; v. 8: p. 34.
1898b *Paururus areolatus* Konow, ♂ ♀. Syst. u. krit. Bearb. d. Siric.-Trib. Siricini. < Wien. ent. Zeit.; v. 17: p. 90.

Known only from Vancouver Island.

Sirex juvencus race *cyaneus* Fabricius

(Fig. 23)

1781 *Sirex cyaneus* Fabricius, ♀. Spec. insec.; v. 1: p. 419.
1837 *Sirex duplex* Shuckard, ♀ ♂. Descr. of a n. sp. of Sirex discovered to attack spruce fir. < Mag. nat. hist.; (n. s.) v. 1: p. 630.
1841 *Urocerus nitidus* Harris. Rep. ins. Mass. inj. to veg.; p. 391.
1866 *Sirex varipes* Walker, ♀. *In* The Naturalist in Vancouver Island and British Columbia. By J. K. Lord; v. 2: p. 342.
1882 *Sirex abbotii* Kirby, ♂. List. Hym. Brit. mus.; v. 1: p. 378; pl. 15, f. 8.
1882 *Sirex hirsutus* Kirby, ♂. *Loc. cit.*; p. 380; pl. 15, f. 6.

Shuckard makes the identification of the male certain, as he notes its occurrence with the female in the spruce fir (*Pinus* [*Picea*] *nigra*), which is an American fir, although the specimens were found in Cambridgeshire, England. He states that they last about a fortnight during the latter part of May and early June. He mentions the confusion existing in the identification of the species, and correctly suggests that it may prove to be *Sirex cyaneus*. The typical race is European, living in Scotch fir (*Pinus sylvestris*). It differs little from *cyaneus*, having however the base of the antennæ red instead of black. Mr. Ingpen relates the occurrence of *cyaneus* in England by thousands in the boards of a house which had been built three years; the lumber was supposed to have been brought from Canada.

Konow in his monograph of the Siricini incorrectly places *abbotii* as the male of *cyaneus*, and he considers *varipes* synonymous. *S. duplex* was not supposed to be new when described, but was so treated on account of the confusion in regard to it, and was thought possibly to be *S. cyaneus*.

Distribution: From northern New York to New Brunswick, Newfoundland and Hudson's Bay, west to Vancouver Island, south to Illinois and Kansas, south along the Rocky Mountains to New Mexico, and along the Pacific Coast to California. A characteristic species of the Canadian and possibly also Hudsonian life zones.

Sirex nigricornis Fabricius

Konow has placed *pinicola* Ashmead as a synonym of *nigricornis*. There seems, however, to be a more or less constant difference in the color of the posterior legs, and it seems that *pinicola* represents a southern race of the more northern *nigricornis*, the two meeting in the region of West Virginia and Delaware.

Norton states that males taken in the same locality as the female were almost precisely the same as the males of *S. cyaneus*.

Key to the Races of Sirex nigricornis

Legs entirely blue-black. *pinicola* (Ashmead)
Legs basally blue-black, the tibiæ and tarsi red. *nigricornis* Fabricius

Race *nigricornis* Fabricius

(Fig. 24)

1781 *Sirex nigricornis* Fabricius, ♀. Spec. insec.; v. 1: p. 413.
1869 *Urocerus nigricornis* Norton, ♀ ♂. Cat. descr. Tenthredinidæ and Uroceridæ N. A. < Trans. Amer. ent. soc.; v. 2: p. 359.
1874 *Sirex morio* Westwood, ♀. Thes. ent. oxon.; p. 115; pl. 21, f. 6.

Distribution: From New York to Delaware.

Race *pinicola* (Ashmead)

1898 *Paururus pinicolus* Ashmead, ♀. Class. horn-tails and saw-flies. < Can. ent.; v. 30: p. 179.
1898 *Paururus nigricornis* Konow. Syst. u. krit. Bearb. d. Siric.-Trib. Siricini. < Wien. ent. Zeit.; v. 17: p. 270.
1904 *Paururus pinicola* Ashmead, ♂. Descr. of four new horn-tails. < Can. ent.; v. 36: p. 64.

Konow has pointed out that *pinicola* is a Latin substantive, and can not be changed to *pinicolus*.

Distribution: From West Virginia to Florida.

Sirex behrensii (Cresson) Kirby

(Figs. 1 and 25)

1880 *Urocerus behrensii* Cresson, ♀. Descr. new N. A. Hym. in coll. Amer. ent. soc. < Trans. Amer. ent. soc.; v. 8: p. 35.

♂. ## In the male which has not heretofore been described the smoky band beneath the stigma is wanting, the smoky margin at the apex less pronounced; the base of the antennæ red; the coxæ black, the rest of the legs reddish brown; the abdomen except the basal two segments red; the free margin of the eighth dorsal segment sufficient to conceal the tenth, even when the latter is extended.

Related to *nigricornis*. The color of the wings seems to be quite constant.

Distribution: Known from California (Berkeley, Sept. 1906, J. C. Bradley) and Nevada.

Urocerus Geoffroy

Urocerus, *gen.* uroceri, M. <οὐρα = tail + κέρας = horn *derivatives*: urocer +

(Figs. 2, 5, 7, 26, and 29-33)

<1758 *Ichneumon* Linnæus. < Syst. nat.; ed. 10, v. 1: p. 560.
1761 *Sirex* Linnæus. Fauna suec; ed. 2: p. 396.
1762 *Urocerus* Geoffroy. Hist. abreg. insec. de Paris; v. 2: p. 264.

The type of the genus is *Ichneumon gigas* Linnæus.

A Key to the North American Species of Urocerus

A. Abdomen entirely black or blue-black.

B. Wings somewhat smoky or yellow; antennæ, except the base and sometimes the apex, cheeks, sometimes lateral spots on the last abdominal segment, base of tibiæ and tarsi white or yellow.

C. Wings somewhat smoky; antennæ except the apex and the basal two or three segments, cheeks, sometimes lateral spots on the abdomen, the base of the tibiæ and tarsi, white. ♀ *albicornis* (Fabricius) Harris

CC. Wings golden yellow; antennæ except the basal segment and all other markings yellow.
♀ *californicus* Norton

BB. Wings brown-black; antennæ from the eleventh segment to the apex white; cornus reddish yellow.
♀ *taxodii* (Ashmead)

AA. Abdomen partly red or yellow, or brownish.

B. Wings subhyaline.

C. Antennæ, tibiæ, and tarsi, second, seventh, eighth, and sometimes the first abdominal segments more or less yellow, the remainder black; wings yellow toward the base and costal margin.
♀ *flavicornis* (Fabricius) Provancher

CC. Antennæ brown, yellowish at the base; tibiæ and tarsi except the anterior, brown, their bases yellow; third, fourth, fifth, and sixth, abdominal segments yellow, the remainder black; wings clear, not yellow.
♂ *flavicornis* (Fabricius) Provancher

BB. Wings brown-black; the abdomen and more or less of thorax reddish or brownish yellow, the apex dusky or blackish.
♂ *taxodii* (Ashmead)

BBB. Wings violaceous; antennæ black, apex yellow; abdomen more or less black or entirely red, apex always red; legs except the posterior tibiæ and tarsi yellow or more or less black. *cressoni* Norton

AAA. Abdomen entirely reddish or brownish yellow.

B. Thorax red or brownish; antennæ, legs, and abdomen yellowish red; wings yellow. ♂ *californicus* Norton

BB. Thorax, head, base of antennæ, and more or less of legs, black; wings violaceous. ♂ and variety of ♀ *cressoni* Norton

BBB. Thorax except metanotum black; apex of abdomen dusky. (See ♂ *taxodii*.)

Urocerus flavicornis Fabricius

(Figs. 8 and 26)

1781 *Sirex flavicornis* Fabricius, ♀. Spec. insec.; v. 1: p. 418.
1835 *Sirex bizonatus* Stephens, ♀. Illus. Brit. ent.; v. 7: p. 114; pl. 36, f. 2.
<1841 *Urocerus abdominalis* Harris, ♂. Rep. ins. Mass. inj. to veg.; p. 392.
1874 *Sirex latifasciatus* Westwood, ♂. Thes. ent. oxon.; p. 114; pl. 21, f. 2.
1893 *Urocerus riparius* MacGillivray, ♂. Washington Tenthred. and Uroceridæ. < Can. ent.; v. 25: p. 244.

This handsome insect is our commonest species of Urocerus There is no doubt that the male described by Harris as *abdominalis* is in part the male of this species, and also probably in part of *albicornis*. In a series of over fifty males I find five that possess but a single spur on the apex of the posterior tibiæ, a character that would place them in the subfamily Tremicinæ according to Ashmead's classification.

Kirby says that *bizonatus* differs in the lighter color of the hind legs and the color of the abdomen, but specimens of *flavicornis* show this same variation.

The North American *flavicornis* is very closely related to the European *gigas*. The difference may be expressed by the following table:

gigas	*flavicornis*
♀	♀
Cornus linear, very slightly widened before the apex; eighth dorsal segment entirely yellow; ninth dorsal segment yellow laterally at apex.	Cornus more distinctly widened before the apex; eighth dorsal segment yellow only at base; ninth dorsal segment entirely black.
♂	♂
Scape usually black; flagellum yellow; seventh dorsal segment yellow.	Scape black; antennæ from the seventh segment to apex often but not always dusky or black; seventh dorsal segment black.

Distribution: From Siberia and Alaska, Keewatin and Labrador south along the Pacific Coast to Oregon, along the Rocky Mountains to Arizona and New Mexico (at high altitudes) and even Mexico, south in the east to northern New York, New Hampshire and Massachusetts.

The species is characteristic of the Hudsonian and Canadian life zones. It seems to be common in coniferous forests of the north. It is entirely absent so far as known from California, and in the states of Colorado, Utah, Arizona and New Mexico is confined as noted by Mr. Rohwer, to the high mountains, 7500 feet and upward. A single record from Nebraska is rather puzzling, and perhaps an error. Farther east it extends south scarcely below the Canadian boundary, having been taken at high altitudes in the White Mountains and a single specimen many years ago at Ithaca, N. Y.

Urocerus albicornis (Fabricius) Harris

(Fig. 32)

1781 *Sirex albicornis* Fabricius, ♀. Spec. insec.; v. 1: p. 419.
<1841 *Urocerus abdominalis* Harris, ♂. Report ins. Mass. inj. veg.; p. 419.
1882 *Sirex stephensi* Kirby, ♀. List. Hym. Brit. mus.; v. 1: p. 375.

The male is indistinguishable, so far as yet known, from the male of *S. flavicornis*.

Distribution: From British Columbia, northern Ontario, Nova Scotia and Newfoundland south to Pennsylvania, Washington and northern Idaho.

This species is common in the Canadian life zone and may extend into the Hudsonian. In the east it extends a little farther south along the Alleghanies than does *flavicornis*. In the west it extends, so far as known, only slightly south of the Canadian border; south of this it is replaced by the very closely allied *californicus*, which indeed has often been looked upon as simply a variety.

In the southeast it is replaced by *taxodii*, to which it is closely related.

Urocerus californicus Norton

(Figs. 7 and 33)

1869 *Urocerus albicornis* var. *californicus* Norton, ♀. Cat. descr. Tenthred. and Uroceridæ N. A. < Trans. Amer. ent. soc.; v. 2: p. 360.

1880a *Urocerus fulvus* Cresson, ♂. Descr. of new Hym. in coll. Amer. ent. soc. < Trans. Amer. ent. soc.; v. 8: p. 35.

1882 *Sirex flavipennis* Kirby, ♀. List. Hym. Brit. mus.; v. 1: p. 380; pl. 15, f. 10.

Distribution: From Vancouver Island south along the coast to the Coastal Mountains of northern California, and along the Sierras to Tulare County, south along the Rockies through Idaho, Utah and Colorado to New Mexico, Arizona, and Mexico.

Urocerus taxodii (Ashmead)

(Figs. 2 and 29)

1904 *Sirex taxodii* Ashmead, ♂ ♀. Descr. of four new sp. horn-tails. < Can ent.; v. 36: p. 63.

Bred from cypress (*Taxodium distichum*).

Distribution: Tryon, North Carolina; and Decatur County, Georgia.

The writer took a typical female specimen flying about cypress on Spring Creek, fourteen miles from Bainbridge in the extreme southwestern part of Georgia, October 1, 1910. A male taken the day previous within a half mile of the same place, also flying about a cypress tree, undoubtedly belongs to the same species, but was largely destroyed by ants before it

could be studied. The following year (June 7-23, 1911) he took four females and three males at the same locality. They were all abnormally small, measuring from 18-20 mm. (♀) and 12-17 mm. (♂), while the female collected the previous autumn measured 33 mm.

Urocerus cressoni Norton

There seem to be three color varieties of this species, most distinct in the female.

Table to the Varieties of Urocerus cressoni

Abdomen entirely red; wings dark fuliginous.	*unicolor* n. var.
Basal six dorsal segments of the abdomen brown.	*cressoni* Norton
Abdomen red, with a black band occupying the third, fourth, and fifth dorsal segments (sometimes less.)	*tricolor* Provancher

These varieties do not represent geographical distinctions.

Distribution: Nova Scotia and Ontario south to Georgia.

Variety *cressoni* Norton

1864 *Urocerus cressoni* Norton, ♀. Notes on Tenthred. with descr. of n. sp. in coll. of the ent soc. <Proc. Ent. soc. Phila.; v. 3: p. 16.

The male differs from the female (see description under variety *unicolor*) by the legs being entirely brownish black.

Variety *tricolor* Provancher

1869 *Urocerus tricolor*, Provancher, ♀. Descr. d'un nouv. Hym. <Nat. canad.; v. 1: p. 17.
1870 *Urocerus tricolor* Provancher, ♂. Nat. canad.; v. 2: p. 77; f. 10.
1874 *Sirex dimidiatus* Westwood, ♀. Thes. ent. oxon.; p. 115; pl. 21, f. 5.
1904 *Sirex fiskei* Ashmead, ♀. Descr. of four new horn-tails. <Can. ent.; v. 36: p. 63.

I have seen the types of *fiskei* Ashmead, and find no reason for thinking that species different from *tricolor*. In one female the legs are entirely black except the base of the posterior tibiæ and metatarsi, and the extreme base of the middle metatarsi. In other specimens the legs are as in *unicolor*.

Variety *unicolor* n. var.

(Fig. 31)

♀. ## Head and thorax black, except the temples, which are creamy; antennæ black at base, the apical fourteen segments creamy. Wings fuliginous, with violaceous reflection; legs black, the anterior tibiæ and metatarsi narrowly creamy white at the base, the middle ones more broadly so, the posterior tibiæ, metatarsi, following and ultimate tarsal segments creamy white except at tip; base of third posterior tarsal segment and claws creamy; abdomen entirely red, opaque and slightly satiny above, polished below. The precornal basin is wide and short, the abdomen less bluntly terminated, and the cornus less elongate, and its neck less constricted than in *taxodii;* ovipositor extending slightly more than the length of the cornus beyond the tip of the latter.

Distribution: Quebec (Joliette, July 9, type, ♀). Mass. (Saugus, August, 1905, paratype, ♀).

Type in the author's collection and paratype in the collection of the American Entomological Society.

Xeris Costa

(Figs. 4, 11, 28, 30, and 35)

Xeris, *gen.* xeris, F. < ξερίς = a kind of plant *derivatives*: xer +

<1758 *Ichneumon* Linnæus. Syst. naturæ; ed. 10; v. 1: p. 560.
<1761 *Sirex* Linnæus. Fauna suec; ed. 2: p. 396.
<1762 *Urocerus* Geoffroy. Hist. abreg. insec. d. Paris; v. 2: p. 264.
1895 *Xeris* Costa subgenus. Prosp. Im. Ital. <Atti. d. r. Acad. d. sci. fis. e mat. Napoli; (2nd ser.) v. 7: p. 295.

As in Sirex the cheeks are white maculate, and the cornus contracted at base. The posterior lateral angles of the head are sharply carinate. The ovipositor is usually longer than the body.

A Key to the North American Species of Xeris.

FEMALES

A. Cornus distinctly constricted at its base.
B. Abdomen except first segment red.
morrisoni (Cresson) Konow

BB. Abdomen entirely black.
spectrum race *caudata* (Cresson) Konow
AA. Cornus not constricted at its base, or very slightly so. [Abdomen except first dorsal segment red; legs black, the tarsi reddish.]
macgillivrayi n. sp.

MALES

Abdomen mostly red. *morrisoni* (Cresson) Konow
Abdomen black. *spectrum* race *caudatus* (Cresson) Konow

Xeris spectrum (Linnæus) Costa

(Fig. 4)

Kirby notes that *caudata* is closely allied to *spectrum*. They are indeed so closely related as to be undoubtedly one species. A careful examination of specimens of both species fails to disclose any very satisfactory characters to separate them even as races. Konow does this as follows:

Legs uniformly reddish yellow, in the ♂ the posterior legs black at base; ♂ with black temples; ovipositor longer than the body. *caudata* (Cresson) Konow
Tibiæ white at base, each temple with a yellowish white spot; ♂ with posterior legs mostly black; ovipositor as long as the body. *spectrum* (Linnæus) Costa

Xeris spectrum race *caudata* (Cresson) Konow

(Figs. 11 and 28)

1865b *Urocerus caudatus* Cresson, ♀. Cat. Hym. in coll. Am. ent. soc. from Col. Terr. < Proc. Ent. soc. Phila.; v. 4: p. 247.
1869 *Urocerus caudatus* Norton, ♂ ♀. Cat. descr. Tenthred. and Uroc. N. A. < Trans. Amer. ent. soc.; v. 2: p. 363.
1874 *Sirex melancholicus* Westwood, ♂. Thes. ent. oxon.; p. 116; pl. 21, f. 8.

Distribution: Inhabits the Hudsonian and Canadian life zones, where it is a common insect, having been found from Alaska, Keewatin, and Nova Scotia south along the Pacific Coast to northern California, and in the Rocky Mountains to Colorado, where it occurs at high altitudes. In the east it has been taken in the White Mountains, and may be expected in the Adirondacks.

Xeris morrisoni (Cresson) Konow

(Fig. 27)

1880a *Urocerus morrisoni* Cresson, ♀ ♂. Descr. new N. A. Hym. in coll. Amer. ent soc. < Trans. Amer. ent soc.; v. 8: p. 35.
1880 *Urocerus tarsalis* Cresson, ♀. *Loc. cit.* p. 52.
1893 *Urocerus indecisus* MacGillivray, ♂. Wash. Tenthred. and Uroceridæ. < Can. ent.; v. 25: p. 243.

Distribution: So far as known, confined to the west coast of the United States from Vancouver to northern California, and Tulare County in the Sierras, and the Rocky Mountains of Colorado and Utah. Occurs in company with *X. caudatus*.

Xeris macgillivrayi new species

(Figs. 30 and 35)

♀. ## Head and thorax dull black, a white spot on the upper part of the temples; antennæ black, shading into reddish yellow on the apical portion. Legs brownish black, the anterior tarsi, middle tibiæ and tarsi and posterior tarsi dull reddish, the posterior tibiæ whitish at extreme base; abdomen except basal plates brick red; the sheaths of the ovipositor concolorous with the abdomen, the ovipositor darker. Wings uniformly smoky, the veins brown, except the costa, which is yellowish.

Head quadrate, the posterior angles rounded; forehead and vertex rugosely confluently punctured, with a longitudinal median channel, and two less distinct lateral impressions; temples smooth and polished, above impunctate, their lower portions with some round median punctures and a row along the margin of the eyes, the lower portion with a short sharp median ridge, not so marked as in *morrisoni;* clypeus very prominent, rugose, its anterior margin smooth, truncate. Third antennal segment slightly exceeding the fourth, twenty-two segments in all, the scape broad, flattened, concave beneath, the under surface closely, finely punctate.

Humeral angles prominently carinate, the pronotum behind them transversely, rugosely, and coarsely ridged; pleuræ shallowly punctate; venter impunctate, smooth and polished. Posterior metatarsus exceeding the length of the following seg-

ments together, the second segment not quite as long as the two following united; claws with a tooth within.

Cornus rather long, but abnormally wide at base, barely constricted in the middle, not altogether unlike the cornus of *Sirex areolatus;* ovipositor extending a little more than twice the length of the cornus beyond the tip of the latter.

Length of the front wing 15 mm.; of the cornus 2.7 mm.; of the ovipositor 15 mm.; total length 20.5 mm.

It gives me pleasure to dedicate this species to my friend and former teacher, Dr. A. D. MacGillivray, in recognition of his signal contributions to our knowledge of the Chalastogastra.

Tremex Jurine

Tremex, *gen.* tremicis, M. irr. <τρῆμα<τετραίνω=to bore through. *derivatives:* tremic +

(Figs. 3, 9, 16, 36, and 38)

<1761 *Sirex* Linnæus. Fauna sueicæ; ed. 2: p. 396.
<1762 *Urocerus* Geoffroy. Hist. abreg. insec. d. Paris; v. 2: p. 264.
1807 *Tremex* Jurine. Nouv. meth. class. Hym.; p. 80.
1837 *Xyloterus* Hartig. Fam. d. Blatt. u. Holzwespen.; p. 385.
1868 *Xyloecematium* Heyden. Ueber das seither unbek. < Manchen von Xyloterus fuscicornis. <Berl. ent. Zeitschr.; v. 12: p. 27.

There is only one North American species.

Tremex columba (Linnæus) Lepeletier de Saint Fargeau

There are three fairly well marked races, of which heretofore only two have been recognized.

A Key to the Races of Tremex columba

A. Entire body fulvous; legs beyond femora yellow; wings dark reddish brown. Race *sericeus* Say.

AA. Abdomen marked black and yellow.

B. Ground color black; second dorsal segment, line at base of third, broadened laterally, wedge-shaped spot on sides of five following segments, the cornus at base, and sometimes spot on sides of ninth segment yellow; head and thorax varied with brown; wings brown or yellowish. Race *columba* (Linnæus) Lepeletier de Saint Fargeau

BB. Ground color yellow; apical line of second to seventh dorsal segments; sometimes apex of eighth and more or less of sides of ninth segments black; head, thorax and antennæ yellowish brown; wings yellow. Race *aureus* new race

Race *columba* (Linnæus) Lepeletier de Saint Fargeau

(Figs. 3, 9, 11, 36 and 38)

1763 *Sirex columba* Linnæus. Cent. insec.; p. 30. (*In* Amoen. Acad.; v. 6.)
1773 *Sirex pennsylvanicus* DeGeer. Mem. hist. insec.; v. 3: p. 593; pl. 30, f. 13.
1773 *Sirex cinctus* Drury. Ill. nat. hist.; v. 2: p. 72; pl. 38, f. 2.
1791 *Sirex americana* Christ. Naturg. d. Insek.; p. 412.
1823 *Tremex obsoletris* Say. Descr. n. sp. Hym. ins. < West. quart. reporter; v. 2: p. 73. [*Reprint,* Lec. ed.; v. 1: p. 74.]
1874 *Tremex maurus* Westwood. Thes. ent. oxon.; p. 116; pl. 21, f. 3.

Distribution: This form is very common in Quebec, Ontario, and northeastern United States, extending south as far as Georgia. It is less common in the eastern provinces of Canada. It extends into the states of the middle west, but in the Rocky Mountains is replaced by the race *aureus,* although a few specimens of the typical form have been found in that district. In the south it is probably replaced by the following race, with which it mingles, however, in the southeast.

Race *sericeus* Say

1823 *Tremex sericeus* Say. Descr. n. sp. Hym. ins. < West quart. reporter; v. 2: p. 73. [*Reprint,* Lec. ed.; v. 1: p. 73.]
1846 *Tremex servillei* Brullé. Hist. nat. ins. Hym.; v. 4; p. 645; f. 2.

Distribution: Southeastern United States, extending north as far as Pennsylvania, and west as far as Utah.

Race *aureus* new race

♀. ## Antennæ, head, thorax, coxæ, trochanters, and femora yellowish brown, sutures washed with black; rest of legs, basal plates, and abdomen, except as noted, yellow; wings yellow, brownish at apex; line on apical margin of third to seventh dorsal segments black, broadest mesally, line sometimes interrupted mesally on sixth and seventh segments, eighth segment wholly yellow, or black at apex, sides of ninth segment sometimes stained black.

Distribution: Colorado (Clear Creek, Sept. 5, 1898; Berkeley, Sept. 11, 1898; Denver, Sept. 13, 1898; Oct. 15, 1899; Ft.

Collins, Sept. 6, 1899); New Mexico (Albuquerque); Arizona.

This seems to be the common form in the Rocky Mountains. A specimen labelled "Canada" in the collection of the American Entomological Society is rather intermediate between this race and the typical form.

Teredon Norton

Teredon, *gen.* teredonos, F. <τερηδών = wood-worm *derivatives*: teredon +

(Figs. 10, 12 and 13)

<1807 *Tremex* Jurine. Nouv. meth. class. Hym.; p. 80.
1869 *Teredon* Norton. Cat. descr. Tenthred. and Uroceridæ N. A. <Trans. Amer. ent. soc.; v. 2: p. 366.
1882 *Teredonia* Kirby. List Hym. Brit. mus.; v. 1: p. 376.

Kirby says that this name is preoccupied and Konow says that it is preoccupied in Mollusca. After careful search I found no such genus, and upon consulting with an eminent malacologist, I was assured that there was no such term in that science. Probably Kirby had reference to the name Pteredo. I have therefore followed recent authors in restoring Norton's original name.

A Key to the Species of Teredon

Wings, legs, and body, except narrow bands on the abdomen, yellow. *cubensis* (Cresson) Norton
Wings hyaline, fuscous at apex, legs and body except abdomen green-black, abdomen red. *latitarsis* (Cresson) Norton

Teredon cubensis (Cresson) Norton

(Fig. 13)

1865a *Tremex cubensis* Cresson, ♀. On the Hym. of Cuba. < Proc. ent. soc. Phila.; v. 14: p. 2.

Distribution: Cuba.

Teredon latitarsis

1865a *Tremex latitarsis* Cresson, ♂. On the Hym. of Cuba. <Proc. ent. soc. Phila.; v. 14: p. 2.

Considered by Konow to be the male of *cubensis*, as is not unlikely.

Distribution: Cuba.

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EXPLANATION OF FIGURES

PLATE I.

Figure 1. *Sirex behrensii*, ♀. From a drawing by the author.

Figure 2. *Urocerus taxodii*, ♀. From a drawing by Miss Annie Sharp.

PLATE II.

Figure 3. *Tremex columba*, ♀. Photograph by the late Professor M. V. Slingerland.

Figure 4. *Xeris spectrum*. Mouth parts. Photograph by Professor C. R. Crosby and the author.

Figure 5. *Urocerus*. Mouth parts. Photograph by Professor C. R. Crosby and the author.

PLATE III.

From drawings by the author.

Figure 6. The wings of *Sirex juvencus cyaneus*, showing the veins labelled according to the Comstock-Needham system.
C—Costa.
Sc—Subcosta; Sc_1 and Sc_2, respectively the first and second branches of subcosta.
R—Radius; R_1, R_2, R_3, R_4, and R_5 respectively the first to fifth branches of radius.
Rs—The radial sector ($R_{2+3+4+5}$).
M—Media; M_1, M_2, M_3, and M_4 respectively the first to fourth branches of media.
Cu—Cubitus; Cu_1 and Cu_2 respectively the first and second branches of cubitus.
1st A, 2d A, 3d A—Respectively the first, second, and third anal veins.
r—The radial cross-vein.
r-m—The radio-medial cross-vein.
m—The medial cross-vein.
m-cu—The medio-cubital cross-vein.
Coalescence of veins or branches of veins is indicated by a + sign.

Figure 7. The wings of *Urocerus californicus*, the cells numbered according to the Comstock-Needham system.
C—The costal cell.
Sc, Sc_1—Subcostal cells.
Sc_2—The second subcostal cell, or stigma.
R, 1st R_1, 2nd R_2, R_3, R_4, and R_5—Radial cells.
M, M_1, 1st M_2, M_3, and M_4—Medial cells.
Cu and Cu_1—Cubital cells.
1st A, 2nd A, and 3rd A—Anal cells.
Ap. —The appendiculate cell.
The cells take their names from the vein or branch of a vein which in a primitive condition forms their anterior margin.
Coalescence of cells is indicated by a + sign.

Figure 8. The wings of *Urocerus flavicornis*, the veins labelled according to a combination of the systems of Konow, Cresson, etc.
c—The costal vein.
sc—The subcostal vein.
em—The externo-medial vein.
b—The basal vein.
r—The marginal or radial vein.
tc^1, rc^2, tc^3—The first, second, and third transverse cubital veins.
cu—The cubital vein.
rc^1, rc^2—The first and second recurrent veins.
d—The discoidal vein.
tm—The transverso-medial vein.

sd—The subdiscoidal vein.
a—The anal vein.
ac—The accessory vein.
ax—The axillary vein.
tl—The transverse lanceolate vein.

PLATE IV.

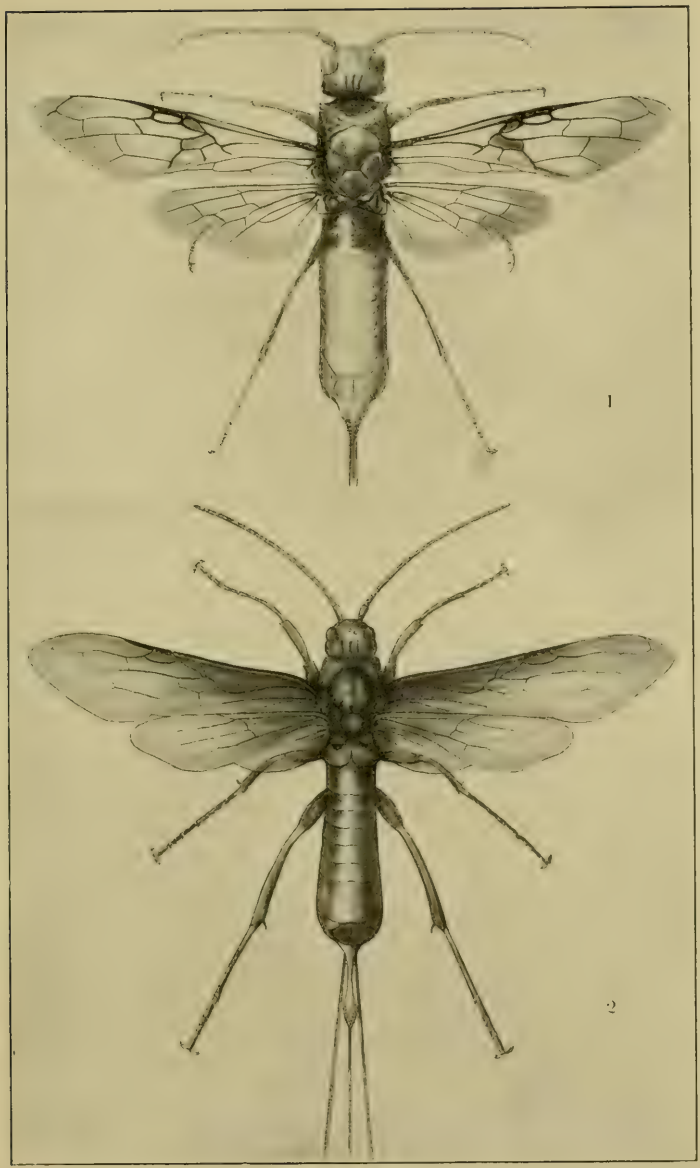
From drawings by the author.

Figure 9. The wings of *Tremex columba.*
Figure 10. The wings of *Teredon latitarsis.*
Figure 11. The wings of *Xeris spectrum caudata.* (R_2 in the hind wing only rarely present).
Figure 12. Posterior femur, tibia, and tarsus of *Teredon latitarsis.*
Figure 13. Posterior femur, tibia, and tarsus of *Teredon cubensis.*
Figure 14. An antenna of *Teredon latitarsis.*
Figure 15. The male genitalia of *Sirex areolatus areolatus.*
Figure 16. The mouth parts of *Tremex columba.*
Figure 17. The mouth parts of *Sirex noctilio.*

PLATE V.

Figures 18-35 from drawings by Miss A. C. Stryke.

Figure 18. *Sirex californicus,* dorsal view of the apex of the abdomen of the female.
Figure 19. *Sirex californicus,* lateral view of the apex of the abdomen of the female.
Figure 20. *Sirex edwardsii,* dorsal view of the apex of the abdomen of the female.
Figure 21. *Sirex edwardsii,* lateral view of the apex of the abdomen of the female.
Figure 22. *Sirex areolatus areolatus,* dorsal view of the apex of the abdomen of the female.
Figure 23. *Sirex juvencus cyaneus,* dorsal view of the apex of the abdomen of the female.
Figure 24. *Sirex nigricornis nigricornis,* dorsal view of the apex of the abdomen of the female.
Figure 25. *Sirex behrensii,* dorsal view of the apex of the abdomen of the female.
Figure 26. *Urocerus flavicornis,* dorsal view of the apex of the abdomen of the female.
Figure 27. *Xeris morrisoni,* dorsal view of the apex of the abdomen of the female.
Figure 28. *Xeris spectrum caudata,* dorsal view of the apex of the abdomen of the female.
Figure 29. *Urocerus taxodii,* dorsal view of the apex of the abdomen of the female.
Figure 30. *Xeris macgillivrayi,* dorsal view of the apex of the abdomen of the female.
Figure 31. *Urocerus cressoni unicolor,* dorsal view of the apex of the abdomen of the female.
Figure 32. *Urocerus albicornis,* dorsal view of the apex of the abdomen of the female.
Figure 33. *Urocerus californicus,* dorsal view of the apex of the abdomen of the female.
Figure 34. *Xeris spectrum caudata,* lateral view of the apex of the abdomen of the female.
Figure 35. *Xeris macgillivrayi,* lateral view of the apex of the abdomen of the female.
Figure 36. *Tremex columba,* antenna of the female.
Figure 37. *Sirex behrensii,* antenna.
Figure 38. *Tremex columba,* antenna of the male.
Figure 39. *Sirex areolatus areolatus,* antenna.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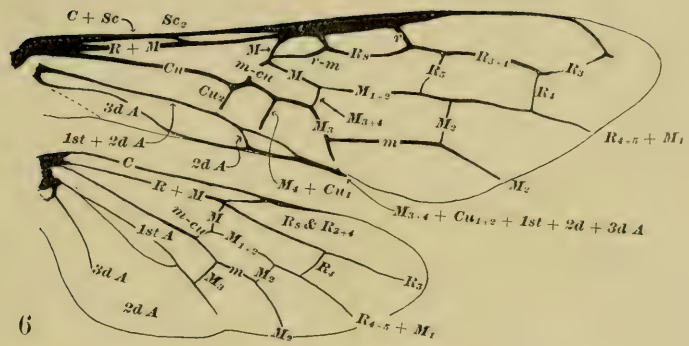
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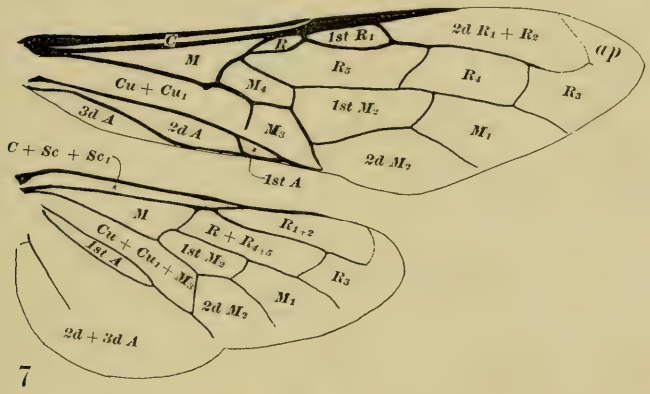
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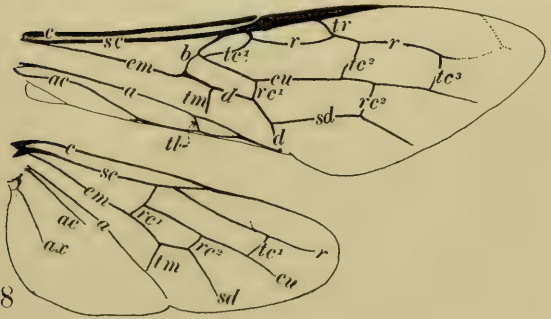
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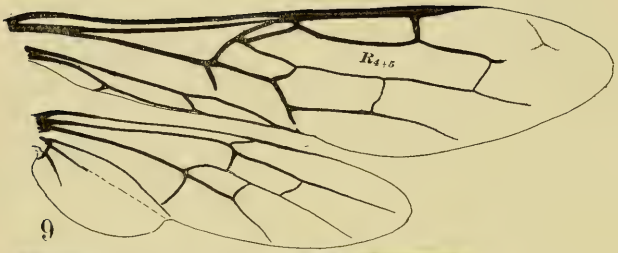

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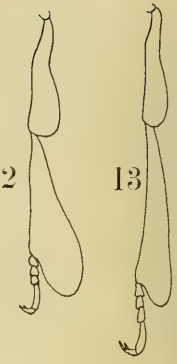

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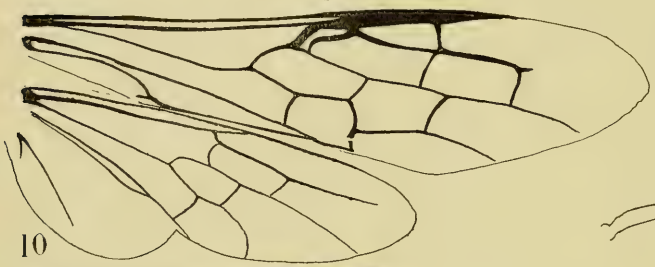

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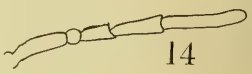

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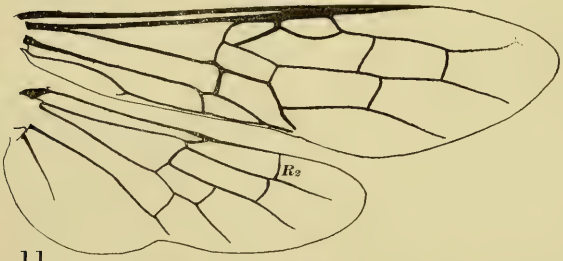

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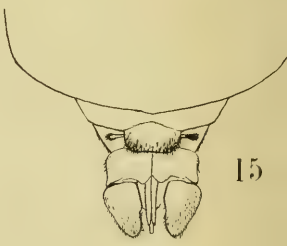

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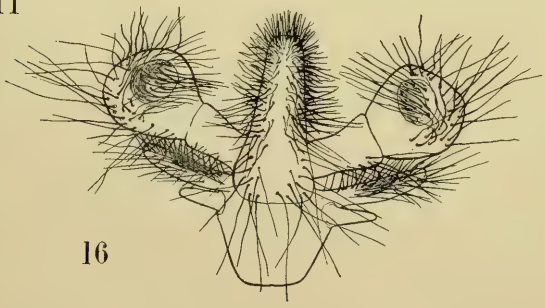

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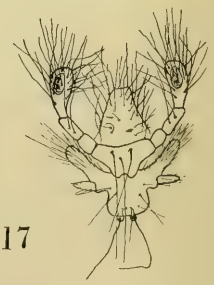

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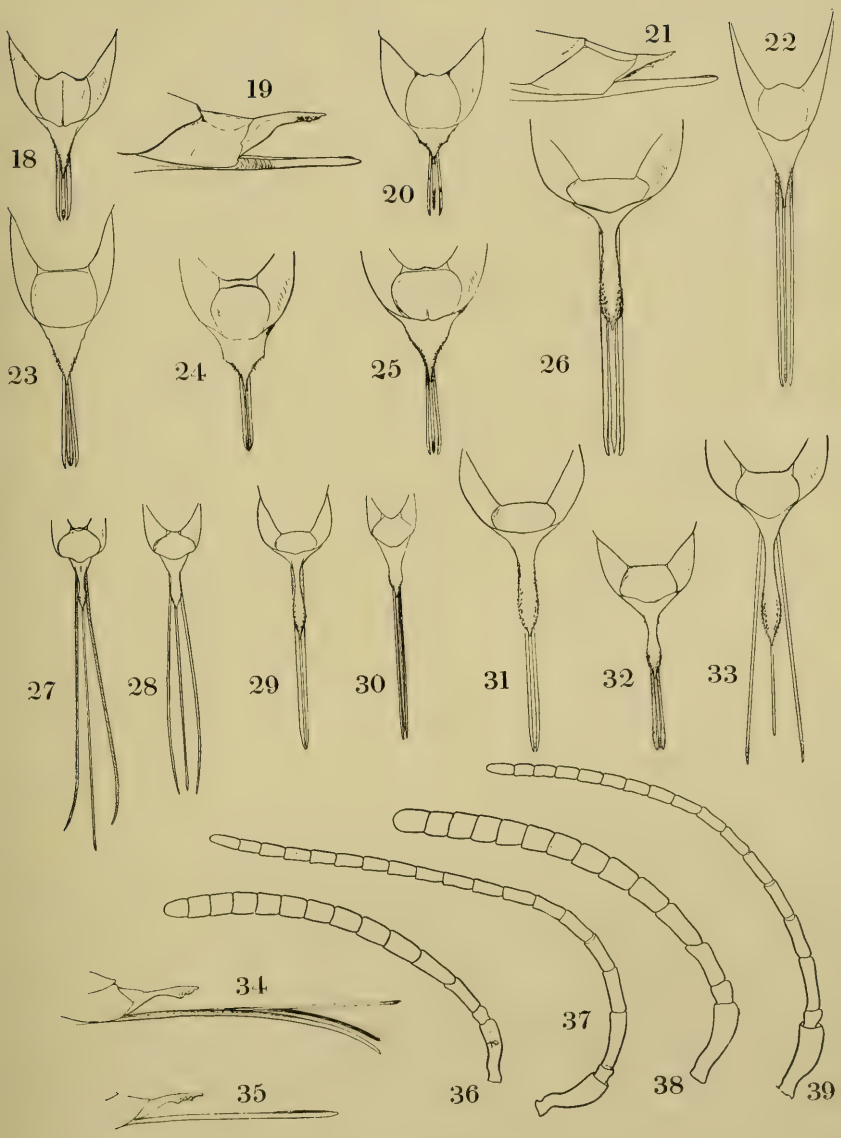
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Announcement

This, the first number of the JOURNAL OF ENTOMOLOGY AND ZOOLOGY in its changed form, starts a new period for the publication.

It is the hope of the editor to have this journal largely entomological in character, but with some consideration given to groups of animals other than insects. It is the plan to have general and special papers so far as possible in each issue. We hope that many who are not specialists in entomology may find much to interest them in these pages. We wish to have the publication broadly zoological and yet at the same time it is the desire to have the journal encourage the work of western America with many of the particular problems and interests of southern California in mind. There will be economic papers to some degree as well as systematic and morphological studies, but the journal will not of course attempt to enter the field of the state and national bulletins. It is hoped, however, that the work of the journal may join with that of these more directly practical publications and by bringing forth more largely technical results and those of a broader range, contribute its share towards the good of the state and country and the advancement of science. Not every article in every number will be of interest to every one, but some part in each number should be of value to any one who has anything to do with insects either in an economic or scientific way and those who are interested in zoology will, we believe, find in this journal ample returns for their subscriptions. The periodical has subscribers in all parts of the world and we hope to greatly increase the number of these. This increase we feel will come to us as time goes on because science is not restricted in its problems or its interests.

The Central Nervous System of Aphorura

WILLIAM A. HILTON

A large number of Collembola of the genus *Aphorura,* species *lutea* and *montis,* were preserved by various methods for a study of the central nervous system. The individuals used were of all sizes, from less than 1 mm. to 1½ mm. in length. No particular differences were noticed between large and small specimens. In all, even the smallest, difficulty was encountered in preservation, because it was hard to wet them with a cold fixing fluid. The method which was most successfully employed was to place the living animals in warm Flemming's fluid, or to fix in the fumes of osmic acid. A large number of specimens were sectioned in all planes, the thickness which seemed best was about 5 microns.

The accounts of the nervous systems of Collembola are very meagre; this is also true of the larger group of Aptera or Thysanura. The work of Boettger '10, on Lepisma has been very useful as a reference. Mention should also be made of the paper of Grassi '89. In this last, three divisions of the brain or supraesophageal ganglion are given for the Thysanura, based on the study of *Campodea, Japyx, Nicoletia, Lepismina, Machilis* and *Lepisma.* His divisions are: (1) The forward one connected with the antennal nerve. (2) The second division connected with the eyes, when they are present. (3) A caudal division connected with visceral nerves.

Among the recent work dealing in part with the nervous system of Collembola, we have the paper of Becker 1910, which is especially concerned with the interesting postantennal organs of this group of insects. The article of Philiptschenko 1912, although an account of the embryonic development of one of the Collembola, *Isotoma cinerea,* has some consideration of the general nervous system of late stages.

One of the most striking things which is noticed in the examination of this little blind Aphorura, is the relatively large size

of the ganglia. Another point which is equally interesting is the small size of the nerve cells. The small size of the animal and the consequent smaller number of nerve cells as compared with larger insects, is apparently not the only difference between this insect and those of larger size. Most of the nerve cells of Aphorura are about two or two and a half microns in diameter. They are much smaller than other cells of the body, even smaller, in fact, than the nuclei of certain cells, such for example as the epithelial cells of the intestine.

The details of structure of the nervous system will not be considered at this time, but a brief description will be given of the ganglia and the chief branches of the nerve centers of the head region. The larger ganglia of the animal are disposed much as shown in Fig. 37, pl. XII, of Philiptschenko's work. However he shows no supraesophageal ganglion in this figure and the position of some of the caudal parts of the nervous system differs from the corresponding portions of *Aphorura*.

In *Aphorura* the supra- and subesophageal ganglia are large and joined together by broad connectives in their forward portions. A section across these ganglia at such a level shows them as one mass with the small esophagus in a little opening in the center of this mass. The connections between the subesophageal ganglion and the first thoracic are not as close as between the two large head ganglia.

There are three large thoracic ganglia about opposite each pair of legs. These are joined together by broad and short connectives. Beyond the third thoracic ganglion and broadly connected with it, is a thick mass which represents the fused abdominal ganglia. This extends into the abdominal region a short distance and ends in a nerve which probably supplies most of the abdominal organs. I found no ganglia below this point but there were some indications of nerve cells where there were no distinct ganglia.

The large abdominal mass broadly fused to the last thoracic center, was found on median sections, to show evidences of being composed of several fused ganglia.

Returning now to the head region we find that the supraesophageal ganglion is fused with the subesophageal in its forward region. Two prominent projections extend forward from the thickest mass of the ganglion from about the region of the connectives; these are the antennal lobes. From the ends of each of these the antennal nerve of each side takes origin and runs forward as a large trunk up into the antenna. From the slightly broader portion of the ganglion, above and quite near its connection with the subesophageal center at the base of the antennal lobe, laterally nerves on each side connect the brain with the group of large sensory cells of the postantennal organ. The connections and positions of these are very much like those described by Becker '10, and shown in his Fig 27. These sense cells were much as described by this author. The little masses in these cells called by Becker "Zwischensubstanz", were very evident. These last usually stained almost as dark as the fat in various parts of the body. Back of the region of the postantennal sense cells the broadest portion of the brain is reached. In this brain, as in one figured by Becker, the caudal end of the ganglion is tri-lobed with the middle portion slightly bi-lobed.

The subesophageal ganglion caudad of the connectives with the brain separates more and more from the upper nerve center as the thoracic region is approached. The figure of Boettger compiled from sections of the head ganglia of *Lepisma* is not far from the condition of the centers of the head of *Aphorura*. From the sides of the subesophageal ganglion three main nerve trunks take origin. These from the head end towards the thoracic region may be homologized as follows: mandibular, maxillary, and labial branches such as found in other insects.

In the consideration of the supraesophageal ganglion no mention was made of an ocular branch or lobe, because there are no eyes and no ocular part of the brain was recognized.

With some difficulty a clypeolabral trunk was distinguished. This nerve is rather small. It takes origin from the base of the antennal lobe near where it joins the supraesophageal ganglion and near the connective on each side. Its origin is more ven-

tral than that of the postantennal mass of cells. I was unable to detect any special lobe of the brain connected with this nerve. Branches from this trunk run dorsally and ventrally. Closely connected with this nerve on each side a little distance forward from the base of the brain is a small ganglion with a few nerve cells. These little centers I believe represent the paired visceral ganglia of other insects. A little cephalad of the level of these small nerve centers and dorsal to the esophagus, between the antennal nerves there is a minute ganglion with a number of little branches. This I believe is the frontal. From it on each side an arched nerve descends to connect with the two lateral ganglia just where they meet the labial nerve. Other branches go to the head region and one descends on the dorsal side of the intestine for some distance.

In order to determine the position of various parts of the ganglia, there was made in blotting paper a model of the large head centers and this, together with a graphic reconstruction from a very perfect series of longitudinal sections, furnished the basis for most of Figs. 1 and 2.

Some General Conclusions

(1) There are two large ganglia in the head, one for each segment of the thorax and a fused mass of nervous tissue in the upper abdominal region.

(2) The abdominal ganglion is clearly made up of several centers fused together.

(3) The supraesophageal ganglion has an antennal nerve on each side. There is also a labral nerve of smaller size and a connection on each side with the postantennal sense cells.

(4) The subesophageal ganglion is joined by broad connectives with the brain and by less broad connections with the first thoracic ganglion.

(5) There are three main nerves connected with the subesophageal ganglion—the mandibular, maxillary and labial.

(6) Connected with the brain are three small ganglia, the frontal and two lateral visceral ganglia. The first of these is very small.

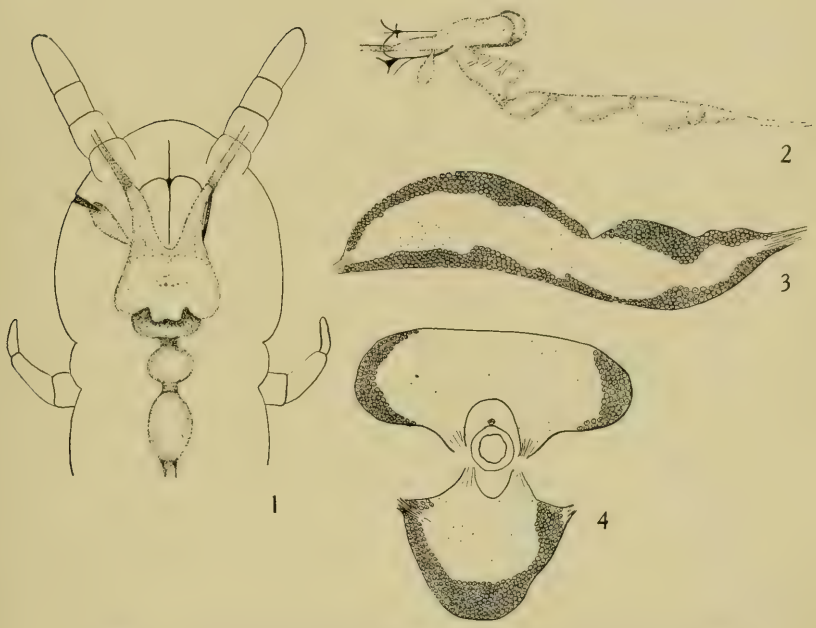

Figure 1. Head and upper thorax of *Aphorura montis* from above. This figure is to show the position of the supra- and subesophageal ganglia. The small frontal ganglion is shown with its arched nerves. On the left side the postantennal organ is shown with the location of the sensory cells connected with it. Only a little of the labral nerve is shown. X about 100.

Figure 2. Side view of the entire central nervous system of *Aphorura,* compiled from longitudinal sections. The smaller ganglia and the chief nerves of the two large head centers are shown in the drawing. X100.

Figure 3. Median longitudinal section of the last thoracic and abdominal ganglia. The ventral side is up, the head end is at the left. X450.

Figure 4. Cross section of the head ganglia. The dorsal side is up. The esophagus is between the two ganglia and a branch from the frontal ganglion is on the dorsal side of the esophagus. The section is taken just back of the connectives. X450.

(7) The connections of the small lateral ganglia are slightly different from those of most other insects so far described.

(8) The ganglia are rather large as compared with the small size of the animal.

(9) The nerve cells are very small, smaller than the nuclei of some other cells of the body.

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(Contribution from the Zoological Laboratory of Pomona College.)

Two New Species of Collembola from the Mountains of Southern California

GERTRUDE BACON

Because of several slight but constant differences between these newly discovered forms and the widely distributed *Aphorura ambulans*, it seemed best to describe new species on the basis of these characters. *Ambulans* has two ocelliform punctures at the base of each antenna; there is only one in the new species. Also the post antennal organ of *ambulans* consists of 12-14 tubercles, while these new species have but 11 and 9. There are numerous tubercles on one of the joints of the antenna in the new forms which are not like anything in *ambulans*. There are a number of other minor differences.

These new species were found at Bear Flats on the slope of Mount San Antonio, at 6,000 feet elevation. It was first noticed that a number of birds were hovering near and occasionally digging in the earth about the bases of the bushes. The soil at this place was very dark and rich in vegetable remains. Although it was several feet down to water, the bushes were in a slight hollow and the earth was a little moist, although it was very dry all about. There were thousands of the insects, usually in little groups and of various sizes. Two kinds were found—a white and a yellow. The yellow was much more abundant. The little creatures were without eyes but the antennæ were actively moved about as the animals changed their positions when they were disturbed. Their movements, although slow because of the short legs, were fairly active. All sizes of both the white and yellow were taken to the laboratory and kept alive for several weeks.

So far this little area on the mountain side is the only place in the mountains or in the canyons where Dr. Hilton or I have found these insects.

Aphorura montis n. sp.

(Figs. 1, 2, and 3)

Length 1.5 mm. Color—White. Body—Long, subcylindrical; sparsely covered with hairs. Head—Slightly elongate. Antennæ—(Fig. 3 A). Shorter than head, blunt; segments four, stout and rounded; I shortest, II and III subequal; IV longest. On the distal part of III and IV, a number of blunt spines or tubercles. Those on III are wider, the ones on the outside being the longest and thickest. No eyes. Postantennal organ

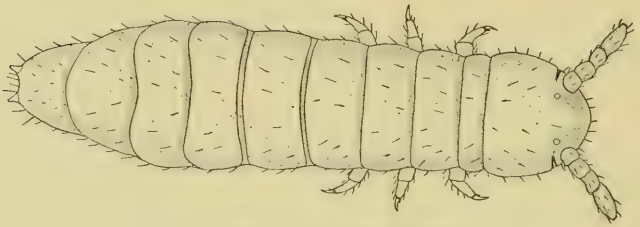


Figure 1. Dorsal view of *Aphorura montis* n. sp.

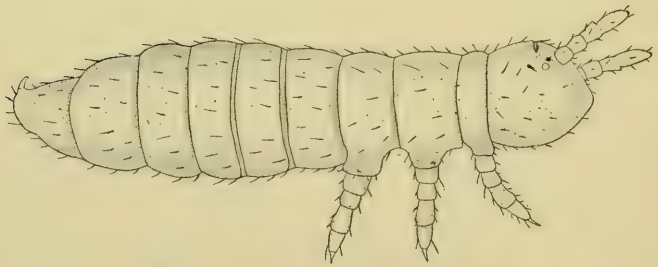


Figure 2. Side view of *Aphorura montis* n. sp.

(Fig. 3, B) present, consisting of eleven raised tubercles in a slight groove or hollow, six on the side toward the antennæ, and five on the other side. Ocelliform punctures at the base of each antenna, one. Thorax—Three segments not fused, the first is small but visible from above. Each bears a pair of legs (Fig.

3, C) which are short and stout. The coxa and trochanter are short and subequal, femur and tibia longer and about equal, tarsus very small and bears two claws without teeth (Fig. 3, D). Superior claw long and broad, inferior very short and narrow. Abdomen—Segments 1, 2, 3, 4 subequal. Segments 5 and 6 longer. Furcula wanting. Anal horns two (Fig. 3, E). The skin is covered with tubercles which are very small and regular. They give the whole body a finely granular appearance.

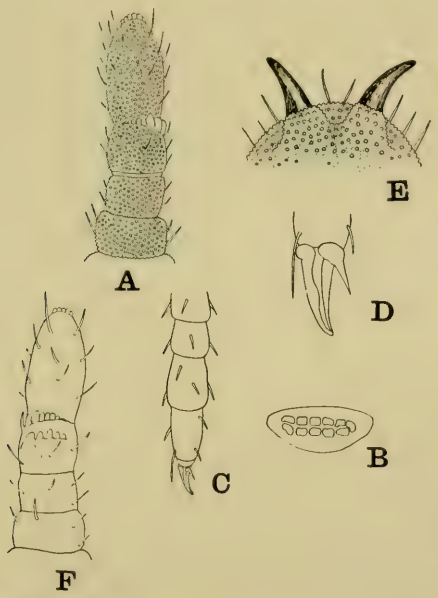


Figure 3. *Aphorura montis.*
A—Antenna with the tubercles of the skin shown.
B—Postantennal organ.
C—Leg with claw.
D—Claw.
E—Anal horns, tubercles of the skin shown.
F—Antenna of *Aphorura lutea.*

Aphorura lutea n. sp.

In general appearance this species is the same as the *Aphorura montis* except that it is yellow in color. The size and shape of the body are about the same. The claws, and number of anal horns and ocelliform punctures are the same. The most important differences are in the color and in the postantennal organ. It contains only nine tubercles, five on the antennal side and four on the other, instead of eleven as in *montis*. Although the antennæ varied in the different specimens, two rows of blunt spines were found on the third segment. One row was found on those of the white species.

(Contribution from the Zoological Laboratory of Pomona College.)

Some Remarks on the Abdominal Air Sacs of Stenopelmatus

EDITH M'CONNELL

In a study of the general anatomy of Stenopelmatus some interesting things were noticed in regard to the tracheæ. The air sacs of the abdominal region in comparison with those of the locust, as described by Snodgrass '03, are more like enlarged parts of the tracheal tubes and are rectangular in shape.

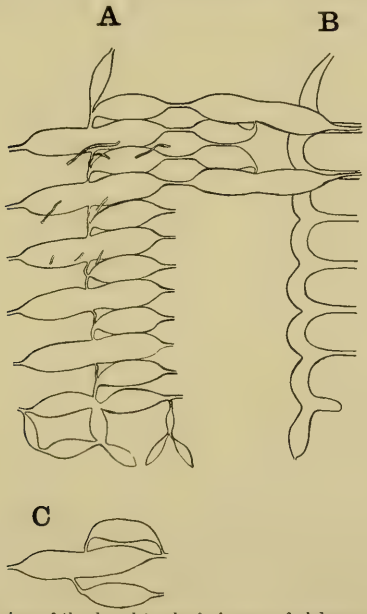


Figure 1. Dorsal view of the dorsal tracheal air sacs of abdomen of Stenopelmatus. X3.
A—Showing air sacs on left side with a variation in arrangement of anterior sacs of right side.
B—Lateral longitudinal trachea.
C—Variation in number and arrangement of posterior sacs.

In the dorsal part there are five, sometimes six, large air sacs on each side. These arise at the spiracles and, with the exception of the first, are paired. The first, as shown in Fig. 1, A, is connected with a smaller air sac. In front of each pair of large sacs is also a pair of smaller ones, about the same width but only one-half as long as the larger and at the lower end connected with the large ones by a small tube. Each large air sac is also connected with the lower part of the small one posterior to it.

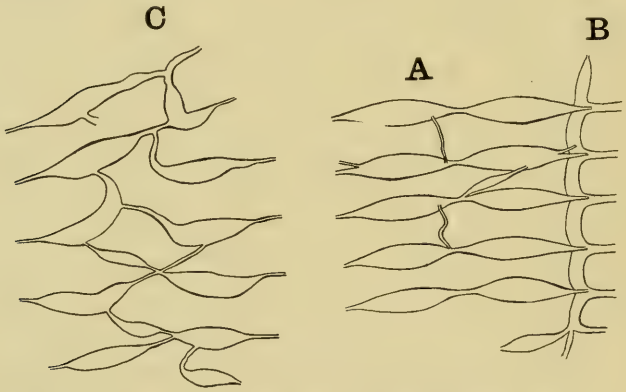


Figure 2. Ventral view of the ventral tracheal air sacs of abdomen. X3.
A—Main air sacs of ventral system.
B—Lateral longitudinal trachea.
C—Variation in number and arrangement of ventral air sacs.

There are some variations in the arrangement of these enlarged tracheal tubes. One is shown on the right side of Fig. 1, A, where the large air sac is in front and two smaller ones lie side by side. In another instance two small air sacs are connected to the first long one on the left side and there are no small ones connected with the second long one. At the caudal end there are several small sacs connected with each other and with one spiracle, as shown in Fig. 1, A. There are variations in this also, since in some a large air sac is connected

with the spiracle and with a large sac opposite and the arrangement of the smaller sacs is as shown in Fig. 1, C.

Along each side is a large tube-like trachea which is connected with six spiracles as shown in Fig. 1, B, and also in Fig. 2, B.

In the ventral part of the abdominal region there are also variations. In some there are five pairs of air sacs, not so wide and more elongated than the smaller sacs of the dorsal region, and uniformly arranged. These are connected with each other and with the trachea which runs along the side, being attached to the outside of the tube at the point where the branches go to the spiracles. Some of these air sacs are attached to the one posterior by smaller tubes as shown in Fig. 2, A. The branches at the caudal end of the long tracheal tube pass in to the internal organs.

Fig. 3 shows a variation from the uniform arrangement although in this specimen there are also the five main air sacs on each side but with different connections. It was difficult on account of the stiff exo-skeleton to open the insect and lay back the body wall without disturbing the natural arrangement of the tracheæ. At first I thought the air sacs as shown in Fig. 3 were drawn out of position but since examining other specimens I have concluded that it is a variation.

In this account there is no description given of numerous small branches from the large air sacs which go to various parts of the abdominal region.

(Contribution from the Zoological Laboratory of Pomona College.)

A New California Coccid Infesting Manzanita

(*Aulacaspis manzanitae* n. sp.)

B. B. WHITNEY
STATE HORTICULTURAL QUARANTINE INSPECTOR
SAN FRANCISCO, CALIFORNIA

Puparium of the female approximately circular; moderately convex; exuviæ subcentral or towards the margin. Color varying from pale yellow to dusky yellow, or pale brown. Diam. 1.75 to 2.25 mm.; puparium light brown or gray to a dark brown; light gray at margin. Ventral scale appearing as a very thin whitish scar on the leaf after the removal of the insect. Male not known.

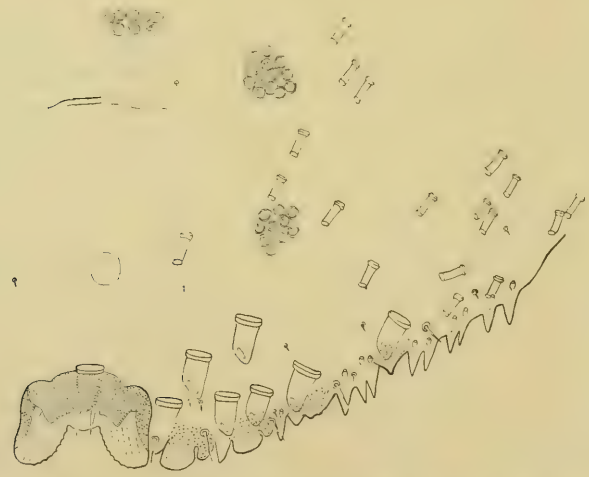


Figure 40. Anal plate of the manzanita scale, *Aulacaspis* manzanitæ n sp. (Original)

Adult female dark with a yellowish pygidium before being boiled in potash; pygidium with five groups of circumgenital glands; the anterior group usually consists of from 6 to 10; the

anterior laterals from 12 to 16; and the posterior laterals from 6 to 10. Formula of ten examples:

Anterior	8	7	8	7	8	8	7	7	6	10
Anterior laterals	12-14	14-14	14-15	13-14	13-15	14-12	13-14	13-13	9-13	16-16
Posterior laterals	8- 9	9- 9	7-10	8- 8	8- 8	8- 8	8- 8	8- 8	7- 6	9- 9

There are five pairs of lobes; median pair largest; with two spines in between and serrated on the inner margin. Second and third pairs are somewhat divided and may appear as double, or

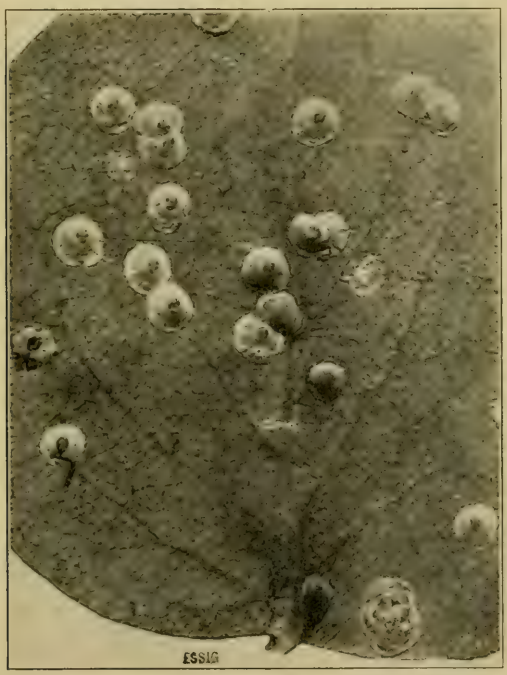


Figure 41. The manzanita scale, *Aulacaspis manzanitae* n. sp. (Photo by E. O. Essig).

a large and small lobe. Fourth and fifth lobes are rudimentary. There is one spine immediately on the outer edge of each lobe or right after; there are also gland spines; the first one between second and third lobe; one between third and fourth lobe, and between fourth and fifth there are from three to four. After the fifth lobe the gland spines vary from six to nine. Out of twenty scales mounted there are five pairs of marginal glands near the margin; one gland directly in center of median lobes; four other glands resembling marginal glands; just back of first, second and third marginal glands numerous smaller ones scattered backwards from near the margin into the abdominal segments. Anal aperture just even or below posterior group; genital aperture just below anterior group. Genital aperture very faint and is generally overlooked.

This scale has been collected at several points in the past by different collectors. At Bowman, by H. H. Bowman, at Colfax by E. O. Essig, and at Dutch Flat, Towle and Blue Canon by E. K. Carnes, E. J. Brannigan and B. B. Whitney. It was invariably found on Manzanita sps. at an elevation ranging from 1,622 to 4,701 feet above sea level. This, however, I believe to be the first recorded description.

Regarding this species Dr. L. O. Howard writes E. O. Essig: "This coccid resembles in some respects *Aulacaspis toumeyi* but differs in that it has its median lobes nearly twice as large and paragenitals more numerous. It has been received before on Acrostaphylos from mountains near Claremont, Calif. This appears to be a very interesting scale and for some time has been placed in our unidentified material of this genus".

A New Genus of Chalcidoid Hym

A. A. GERAULT

Tribe ISOPLATINI

Coelocybella new genus

Female:—Head normal, rounded, the vertex broad, the lateral ocelli distant from the eye margin, the antennæ inserted near the middle of the face, slenderly clavate, 13-jointed with three ring-joints, five funicle joints and three club joints, all these joints wider than long excepting the conical distal joint of the club. Pedicel long obconic, as long as the four joints following (the ring joints and the proximal funicle joint), half as long as the cylindrical scape. Occipital margin obtuse; prothorax conical, short; mesoscutum with complete, distinct parapsidal furrows, scutum slightly longer than the ungrooved scutellum. Propodeum with a very weak median carina, the spiracles moderate in size, round, no lateral carinæ nor sulci. Abdomen sessile, broad oval, depressed, about as long as the thorax, the second segment about a third of its length, the ovipositor not exserted, the abdomen from dorsal aspect ovate, widest about the middle, wider than the thorax. Submarginal vein unbroken, at least two and a half times longer than the marginal, the latter nearly twice the length of either the stigmal or post-marginal, both of which, for them, are moderately long, the stigmal vein with a rather large rounded knob and a distinct neck which is as long as the diameter of the knob. Discal cilia dense and fine, the marginal very short. Tarsi five-jointed, the tibial spurs single, the intermediate longer, one very long, the posterior one short, stout. Non-metallic, marked with yellow, the wings hyaline. Abdomen wider than the head or thorax. Axillæ separated by a short distance. Mandibles bidentate, the inner or second tooth truncate, unequal in the two mandibles.

Male:—Not known.

Because of the venation, this genus will not be confused with the Tetracampini but its five-jointed tarsi make it unique for the

Elachertinæ, where I had first placed it by mistake. From the genera of its tribe it differs in bearing several more joints in the antennæ, in having the latter differently inserted and in venation.

Type:—The species described herewith (*variegata*).

Coelocybella variegata new species

Female:—Length, 1.75 mm. Opaque black marked with yellowish brown or lemon yellow as follows: Caudal margins of the eyes, the face, cephalo-lateral angle of the parapside, all margins of the scutellum except the posterior one, vertexal margin of eyes more or less, lateral margins of scutum narrowly, lateral and caudal margins of axilla, the caudo-lateral angles of the propodeum (lemon yellow), the base of the abdomen rather broadly (bright lemon yellow), the yellow invaded and divided by an acutely triangular shining black medial area, its base proximad, the incisions following segments 2 and 3 on each side, the whole incision following segment 4 and the tip of abdomen; the yellow on the head also nearly lemon yellow. Legs dark lemon yellow, including the coxæ, the tarsi distad more or less fuscous. Venation smoky black. Pedicel more or less dusky. Ring joints enlarging distad; first and second funicel joints subequal, longest of the funicle.

Male:—Not known.

Described from five female specimens mounted together on a card in the Queensland Museum, labelled "Brisbane. H. Hacker. 11/7/11".

Habitat:—Australia—Brisbane, Queensland.

Types:—No. Hy1204, Queensland Museum, Brisbane, four of the above specimens on the same card, plus one balsam slide bearing female antennæ and a posterior leg.

Later, two more females were found in the same collection labelled "Bred from Gall No. 10, 17/6/11. Brisbane. Hacker.

Scutellista cyanea Motsch., Bred from *Phenacoccus artemisiae* Ehrh

E. O. ESSIG
SECRETARY STATE HORTICULTURAL COMMISSION
SACRAMENTO, CALIFORNIA

On a collecting trip during the month of May, 1911, in the Sespe Canyon, Ventura County, California, the writer succeeded in procuring a large number of specimens of *Phenacoccus artemisiae* Ehrh. Among the specimens collected one was noticed to be parasitized and was placed in a small vial. From this specimen an adult *Scutellista cyanea* Motsch. was bred. To the knowledge of the writer this parasite has not been bred from a coccid of this type and the record is worth preserving. It is interesting also to note that the specimens collected were far up in the mountains, which shows that *Scutellista cyanea* Motsch. is quite common throughout all parts of southern California. The writer has bred it from black scale far up in the mountains in other localities of Ventura County.

Shorter Articles and Reviews of Recent Important Literature

NATURAL CONTROL OF WHITEFLIES IN FLORIDA

A. W. MORRILL, PH. D., AND E. A. BLACK, PH. D.

Investigations of fungus parasitic on whitefly have been conducted by the authors in 1906, 1908, 1909, and by the authors and Mr. E. L. Worsham of Georgia in 1907.

In Florida there are three lady-beetles that feed upon whitefly eggs and larvæ but do not greatly check the fly. They are *Chilocorus bivulnerus* Muls., *Cycloneda sanguinea* L., and *Scymnus punctatus* Melsh. There is also a capsid bug and two or three chrysopids as well as several species of spiders, some ant species and a thrips, all of which are to some extent predaceous on whitefly.

Whitefly seems to decrease markedly during strong, drying winds and large range of temperature. Unexplained mortality is also a large factor in natural control, as are dropping from the leaves and overcrowding.

It is about fungi parasitic on the fly, however, that the authors have most to say. Of these, *Aschersonia aleyrodis* Webber (red fungus) sends its mycelial rootlets into larvæ of the fly and thus kills them. It is almost free from hyper-parasitic fungi.

Aschersonia flavo-citrina P. Henn. (yellow fungus), closely resembling the red, is parasitic on the cloudy-winged whitefly but is itself subject to a hyper-parasitic fungus (*Cladiosporum* sp.) which, particularly in dry seasons, prevents its being very effective.

The brown fungus (*Aegerita webberi* Fawcett), also infests whitefly, often with great success, since its hyper-parasitic fungus (*Comothyrium* sp.) seems scarcely to check its work.

A number of fungi are next spoken of, which it appears are of no substantial value in reducing whitefly. They are white-fringe fungus, *Sporotrichum,* and the cinnamon fungus.

Various ways of infecting trees with these fungi have been tried, such as spraying with water-mixtures of spores, rubbing with infested leaves, etc. The cost of infecting an orchard is very low and if properly done should pay well, particularly since the fungi in large areas are naturally more effective.

There is a slight damage done the leaves of citrus trees by these fungi, but it is seldom of any importance. Indirectly, however, by hindering the use of fungicides in the orchard these fungi may be charged with some damage.

Fungi under ordinary conditions and for a term of years have, unaided, controlled white-fly to the extent of about one-third absolute efficiency, the authors believe.

There are in this Bulletin No. 102 of the Department of Entomology a number of original plates showing various stages of infection by the several fungi.

W. B.

SEEKING FOR PARASITES OF THE "WHITEFLY" AND THEIR ATTEMPTED INTRODUCTION INTO FLORIDA

R. G. WOGLUM
UNITED STATES DEPARTMENT OF AGRICULTURE

In 1910 the sum of $5,000 was set aside by Congress for investigation of possible parasites of the "whitefly" (*Aleyrodes citri*). Mr. R. G. Woglum was chosen for the errand, though he was at the time testing the efficacy of hydrocyanic gas in killing scale insects. He traveled through Southern Europe, Ceylon, and India, where he finally discovered a lady-beetle (*Crytognatha flavescens motsch.*) feeding on the fly. At Lohore, in the Punjab, an internal parasite was discovered which was named *Prospaltella lahorensis*. Living specimens were at length secured with difficulty and with these and a quantity of the "whitefly" food supply the return trip to Florida was attempted. Mr. Woglum succeeded in landing in Orlando, Florida, twenty-eight healthy lady-birds and some *Prospaltella* on December 2, 1911. Owing to the naturally

dormant condition of "whitefly" in Florida at this season and also to the severe weather of that winter, both the beetles and the *Prospaltella* failed to survive.

With proper preparation of a stock of the insect food for the parasites, and with proper regulation of temperature and other conditions, Mr. Woglum thinks that another trial at importation could be carried to a successful conclusion.

W. G. Brewster.

THE PURPLE SCALE (*LEPIDOSAPHES BECKII*)

H. J. QUALE

Bull. No. 226, College of Agr. Univ. Cal. Publications

In this bulletin a history of the purple scale is given. This scale was introduced into California in 1888 or 1889. From all indications it came directly from Florida with a shipment of trees.

Some of the leading entomologists of the state knew that the Florida stock was infected with the purple scab, but they had reason to believe that it was harmless in this climate. The result of this has been that at present the purple scale occurs in the following counties of California: San Diego, Orange, Los Angeles, Ventura, and Santa Barbara. The reason that it does not occur in some of the other counties may be due to the rigid quarantine that has prevailed against the scale in those sections.

From an economic standpoint the purple scale ranks third. Its distribution is not so wide as the black, red, and yellow, but when it does occur it is the most serious of all, because it becomes so incrusted on the leaf, branch, and fruit which it attacks, that it yields less to treatment.

The purple scale in this country is almost entirely a fruit insect. It rarely attacks common trees or shrubs growing in the vicinity of citrus trees. The eggs are oval in shape, about .25 mm. long. The larva is flat and oval, about .78 mm. long. It usually wanders over the plant for a time before coming to

rest. Experiments have shown that when the temperature is about 89 it travels two or three times as fast as when the temperature is 65. On the whole if it was left to travel by itself the distribution would be very slow.

Very little is said about the parasite of this scale in California, but where fumigation and spray have never been used as high as 40 per cent. of the scale has been parasitised.

This article shows how necessary it is to keep the quarantine as rigid as possible and keep on the lookout for a parasite that will not injure the trees.

C. A. Perrin.

THE RED SPIDERS AND MITES OF CITRUS TREES

H. J. QUALE

College of Agr. Univ. of Cal., Publications.

The two most important species to the citrus growers in California are the red spider and the six-spotted mite. Both species were introduced into California from Florida, the first in 1890, the last in the late eighties.

These animals live and breed entirely upon the trees and are only incidentally found on the ground. They are most abundant during May and June but are sometimes abundant at other seasons. When in small numbers they are not noticed but that is the time to get control of them.

The red spider (*Tetranchus mytilaspidis*) is the worst pest and is the most widely distributed. It is against this species that most of the control work is directed. This species is told from the other by its red color and the fact that the bristles over the body arise from prominent tubercles. The eggs are told by the guy threads which radiate from vertical stalks.

The six-spotted mite (*T. sexmaculatu*) is slightly smaller than the red species. It is never red in color. The eggs are white or yellow and perfectly spherical.

The control of these species is not difficult or expensive if handled in the proper way at the proper time. Fumigation has

been tried with little effect. A number of parasites are named and described in this bulletin. The most satisfactory way to hold these in check is by the ordinary lime-sulphur spray somewhat diluted. *C. A. Perrin.*

THE STRUCTURE AND METAMORPHOSIS OF THE FORE-GUT OF *CORYDALIS CORNUTUS* L.

ROBERT MATHEWSON

Jour. of Morph., Vol. 23, No. 4, 1912.

The fore-gut has five well marked regions: pharynx, esophagus, gizzard, portion between esophagus and esophageal valve, and esophageal valve.

The pharynx is provided with a series of dilator muscles attached to the walls of the head. The esophagus has a large number of longitudinal folds. The gizzard has powerful teeth, which from their arrangement and the arrangement of the muscles in this region, seem to show that they are for grinding and crushing. The esophageal valve is short and is lined with four strongly chitinized ridges which alternate with the cæca.

The metamorphosis of the fore-gut is of a generalized type. The larval epithelium becomes partly broken down and the cells destroyed are replaced by the division of rejuvenated larval cells. The nuclei always divide mitotically and every spindle is located at the side of a vacuole. The dividing cell migrates towards the inner surface, though it retains connection with the basement membrane. The histolysis and histogenesis of the muscular coats are also generalized processes. The muscles liquefy in place. The greater number of the larval nuclei become rejuvenated and around them as centers the new fibrillar structures are developed.

The role of the leucocytes is a comparatively unimportant one. They are present throughout pupal life and seem to engulf small particles of the broken down tissues. They do not take active part in the destruction of the larval muscles or epithelium.

The paper is illustrated by four plates from very fine photographs.

THE CONTROL OF MOSQUITOS

Fred Knab, Science, January 24, 1913

There are some points in this short article that should be very generally known.

The problem of mosquito control is part of the work of disease prevention, as is well known. There are very few communities now where the relation of these insects to malaria is not fairly well understood. There are, however, a number of facts which are new to most of us. The old idea of destroying the insects was largely based on experiments with one species. People must learn that there are numbers of species and some of these have different habits. It used to be supposed that all adult females hibernated in cold weather and that the eggs were deposited and the new generations came on in warmer weather. This thought has led to a failure in the control in many cases. Oiling and petralizing in warm weather misses many. Most of the mosquitos are from larvæ developed in early spring snow water. The best remedy is the removal and the burning in late autumn of all plant debris and dead leaves from dried out pools. If they cannot be burned they should be stacked on high and dry ground. Almost all of the eggs are deposited on dead leaves and require only a little moisture to develop.

F. R. Cole.

BEITRAG ZUR SYSTEMATIK UND BIOLOGIE DER "IXODIDÆ"

DR. H. DE BEAUREPAIRE ARAGAO

Memorias de Oswaldo Cruz. Rio de Janeiro, Vol. IV, Pt. 1, 1912.

This article deals chiefly with *Amblyomma aganum* n. sp., a species of tick found upon Bufo, boa constrictor, and other cold blooded animals. The adult measures 5.6 mm. by 3.7 mm. when in a condition of hunger, and about 17 mm. by 12.6 mm. when full of blood. The color is dark brown, with three copper-colored spots on the scutum. The larvæ and nymphs show a con-

siderable variation in color due to a difference in nourishment. Those which suck blood are a blue-gray color, while those which, due to unfavorable location or overcrowding are forced to live upon lymph, are of a much lighter color. A complete description of the life history, which covers at least ninety days, is given, as two generations were reared in the laboratory and careful observations made. An interesting result of these observations was the discovery that there were no males among the several thousand specimens examined. The experiments are now being continued, with the purpose of studying this parthenogenesis, and the results will be published later.

Animals bitten by these ticks apparently suffer not only from loss of blood, but from a toxic substance secreted by the tick, as the bite of more than ten proves fatal to a toad or of about one hundred to a boa constrictor 1½ meters long. That death was not due to a parasite introduced into the animal was shown by examination of the blood.

Mabel Gurnsey.

ADDITIONS TO OUR KNOWLEDGE OF THE ANTS OF THE GENUS MYRMECOCYSTUS WESMAEL

WILLIAM MORTON WHEELER

Psyche, Dec., 1912.

All the known species and subspecies of the genus are within the confines of the United States.

M. melliger mimicus Wheeler is described from several places including Whittier, Cal. The variety *semirufus* from Point Loma. *M. mexicanus mojave* Wheeler was found in Pasadena and Claremont. A photograph of a number of this species is reproduced. In Claremont the nests of about twenty were examined. "The craters of these were found to vary from 4-8 inches in diameter, with a central opening ¼ to ¾ of an inch across. They were in dry hard soil, along roads or paths in situations where there was considerable vegetation, either chaparral, live-oaks or scrub-oaks. In such localities the ants

probably obtain their supply of nectar from the galls or from coccids and aphids on the oaks or other components of the chaparral. Mr. Leonard has given more extensive accounts of their habits at Point Loma. He found that they were nocturnal. They visit aphids on carnations and roses, and the nectaries of the pepper tree, rattle-snake weed, honey plant, and *Ceanthus cuneatus* of chaparral.

SOME CHANGES IN THE GENERIC AND SPECIFIC NAMES OF PLANT LICE

In the paper on California plant lice which appeared in the last issue of this journal there should be the following changes: *Monella californica* for *Callipterus californicus, Eichochaitophorus* for *Eikochaitophorus, rufrum* for *rufu, Fullawaya* for *Davidsonia, Mycrella* for *Micra, Typha* for *Typho.*

In the December number of the Zoologischer Anzeiger of 1912, there is a short paper on the family Pantophthalmidæ of the Diptera. There are fifteen text figures and several new species described.

In Vol. I of the Memoirs of the Queensland Museum, issued November 27, 1912, there are a number of important entomological papers. There is an article of 124 pages by A. A. Girault on Australian Hymenoptera and three shorter ones by W. J. Rainbow on spiders.

In the Bulletin de la Societe Entomologique de France, No. 1, 1913, there is given a list of the members of the society. This list takes up more than half of this number of the publication and covers 38 pages.

In the journal "Insecta", published by the entomological station of the faculty of sciences of Rennes, there is a portrait of Latreille, who was born in 1762 and died in Paris in 1833. By the writer of the sketch, Latreille is considered to be the greatest of all entomologists. He it was who first placed insects in their natural orders and established the principal families.

L'ALTISE DE LA VIGNE

F. PICARD

Le Progres Agricole et Viticole. Vol. XXXIV, Feb., 1913.

The author describes this small leaf beetle (*Haltica ampelophaga*) which is doing great damage to the grape vines in the central part of France. The adults appear in early spring and eat the leaves, which are very tender at this time. The eggs are laid on the under side of the leaves and the larvæ appear in about ten days and live on the leaves. At the beginning of the summer they change to nymphs which work in the ground. In ten days the adults come forth and attack the vines. At the first cold weather they hide under stumps, vegetable mold, etc.

The multiplication of these insects is held somewhat in check by their natural enemies, other insects and fungi. The methods for destroying them are: shaking them into a receptacle, burning all leaves and rubbish in the winter, and the use of insecticides in the spring before the eggs are laid.

G. Bacon.

In the last number of "Marcellia", Fac. IV, Vol. XI, 1913, there are a number of important articles, among them the following:

The Galls of Africa, by C. Howard; Galls of Tripoli, by A. Trotter; Arctic and Russian Galls, by Toepffer.

AN ORPHAN COLONY OF *POLISTES PALLIPES* LEPEL

C. H. TURNER

Psyche, Dec., 1912.

Workers which had never seen the widow-mother of the colony nor associated with any other wasps, performed all the activities of such wasps except egg-laying and paper-making. The large larvæ after fasting for eight days, feeding on honey only for the next three days and receiving their normal diet for the remainder of their larval life, constructed perfect cocoons and emerged as normal imagoes. The small larvæ died.

After being restricted to a honey diet for several days, the wasps became cannibals.

In a preliminary note by M. J. Rosenau and Chas. T. Brues, in Psyche for December, 1912, there is a statement concerning the transmission of poliomyelitis through the agency of *Stomoxys calcitrans.*

They have apparently transferred the virus of poliomyelitis from monkey to monkey through the bite of the stable fly, *Stomoxys calcitrans.* This does not appear to be simply a mechanical transference, but rather a biological one, requiring a period of extrinsic incubation in the intermediate host.

NEUE BEITRAGE ZUR KENNTNIS DER TERMITOPHILEN UND MYRMECOPHLIEN

E. Wasmann Zeit. f. Wiss. Zool. CI Bd., 1 Heft. 1912.

This important paper of Wasmann gives an account of many new species of Coleoptera which are found as guests in ant nests. Of the family Staphylinidæ there are eight new species described. The family Pselaphidæ has four described under it. The family Thorictidæ has three. The family Tenebrionidæ has one new species. There is a very full account given of all of these and others. The author from the light of his studies is of the opinion that the guest habit could not have arisen through "natural selection". He thinks that natural selection is not the chief factor in organic evolution, although it is a factor. He believes that the guest habit has arised through spontaneous variation.

DER GESCHLECHTSAPPARAT VON *DYTISCUS MARGINALIS* L.

Carl Demandt Zeit. f. Wiss. Zool. CIII Bd., 2 Heft. 1912.

This long paper is a detailed description of the sexual organs. There is an account of the organs in both sexes, including histological details. There are 128 pages and 74 text figures.

STUDIES AMONG THE COCCINELLIDÆ, (COL.)

A New Species

F. W. NUNENMACHER

Piedmont, California

Entomological News, Vol. 24, No. 2, Feb., 1913.

The new species *Coccinella bridwelli* described.

Locality—Tahquitz Valley, San Jacinto Mountains, California. Found by and named after Mr. J. C. Bridwell.

A new entomological magazine has made its appearance, "Insecutor Inscitiæ Menstruus." The editor and publisher is Harrison C. Dyar of Washington, D. C. The object of this publication is "to dispel to some degree our general ignorance of the forms of insect life by descriptions of species and genera, life-histories, and other pertinent facts." The January and February numbers have so far been published. They include short systematic articles, chiefly by Dyar and Frederick Kalb.

G. Bacon.

ON A NEW TERMITOPHILOUS GENUS OF THE FAMILY HISTERIDÆ

ERIC INJOEBURG

Ent. Tidsk. Haeft. 1-2, 1912.

This is the first termitophilous beetle from Australia.

The body is short, broad, and shining. The head is not visible from above. The border of the fossa of the antena is visible from above and carries a distinct pencil of yellow hairs. The elytra are of a very peculiar shape, the humeral corner is strongly produced into a horn which carries at the top a long pencil of hairs. The beetle was found in a colony of the termite *Eutermes*. The animal was surrounded by workers and soldiers. Apparently the hairs in pencils are hollow and secrete a semi-fluid substance. The termites gathered about these, sucking or eating the secretion.

There are three line cuts and one fine plate.

NEW NORTH AMERICAN TACHINIDÆ (DIPT.)

W. R. WALTON

Bureau of Entomology, Washington, D. C.

Entomological News, Vol. 24, No. 2, Feb., 1913.

Two new species are described.

The first form described, *Eutrixoides jonesii,* "adds a new genus and species to the small aggregation of Muscoids known to be parasitic on beetles of the genus Lachnosterna." Habitat Anasco, Porto Rico, and collected by Mr. T. H. Jones, in honor of whom the species is named.

The second form is *Chaetophleps crassinervis,* described by Mr. Walton. Type—A female collected by the author at Hyattsville, Maryland.

R. E. Gardner

News Notes

FORDYCE GRINNELL, JR.

"Nature is ever making signs to us, she is ever whispering to us the beginnings of her secrets; the scientific man must be ever on the watch, ready at once to lay hold of Nature's hint however small, to listen to her whisper however low."

—Michael Foster.

Mr. E. P. VanDuzee, the hemipterist, formerly of Buffalo, N. Y., has come to Southern California to live, probably at San Diego, and is bringing his large and important collection and library with him. He visited in Pasadena in December.

Plans are being prepared for a building for the Southern California Academy of Sciences in Los Angeles. The building to consist of a lecture auditorium, general exhibition floors, a library and special collection rooms.

Professor J. M. Aldrich, of the University of Idaho, is studying the fruit flies (Trypetidæ) of the world, and expects to be engaged in studying this interesting group of insects for several years.

Mr. W. M. Mann, well known to many Californian collectors, now of the Bussey Institution of Harvard, has been collecting for several months in the island of Haiti.

The January number of the Bulletin of the Southern California Academy of Sciences contains an article on the oil fly by C. O. Esterly, giving additional notes and criticisms to those published by Crawford in this journal.

Dr. Wm. E. Ritter, director of the Scripps Institution for Biological Research at La Jolla, recently addressed the biological section of the Southern California Academy of Sciences in Los Angeles on "The Pelagic Organisms Off the Coast of Southern California."

Mr. F. W. Bryant, a well-known student and collector of shells in San Diego, died recently in the Hawaiian Islands.

The County Museum Building in Exposition Park, Los Angeles, has been opened to the public. The skeletons of extinct mammals from La Brea Rancho are of special interest.

A Study of Some Specific Characters of the Genus Pseudococcus

P. E. SMITH
ENTOMOLOGICAL LABORATORY OF CORNELL UNIVERSITY

The first part of this study was published in September, 1911.* In that paper an examination was made of the characters commonly used in descriptions of species of this genus. This paper is a continuation of the preceding study and in it new characters or characters not commonly used in systematic work are examined. Five species, namely, *agrifoliae* Essig, *crawii* Coq., *obscurus* Essig, *citri* Risso, and *longispinus* Targ. are considered. Adult specimens have been used throughout. As a considerable number of specimens of each species were available the study has been comparative.

The work was carried out under the direction of Prof. Alex. D. MacGillivray and the writer wishes to again express his appreciation for the invaluable aid received.

Following is a discussion of the various characters for each species.

ANAL RING—(Figs. 1-5)

So far as known to the writer a study of the anal ring has not been made nor has it been figured in any detail. In ordinary mounts the complete anal ring very seldom shows with any clearness because the entire ring or parts of it at least are at an angle to the slide. The ring must lie flat and parallel to the slide to get the correct relations of the parts. To accomplish this the specimens were carried through the clearing stage in the usual way. Then under the dissecting microscope the anal ring and lobes were dissected out and mounted. In this way flat mounts were secured from which camera lucida drawings could be made.

The anal ring consists of two unclosed concentric circles of wax pores, between which are three pairs of stout setæ. Within this,

*Ann. Entom. Soc. Am. Vol. IV, No. 3, pp. 309-327.

nearer the caudal* end than the cephalic end of the ring, is the anal aperture. The inner circle of pores is closed at the forward end and bulges out between the two anterior setæ forming a marked concavity. Posterior to the caudal pair of setæ the inner circle of pores continues on each side for about one-third of the arc of the circle bounded by these two setæ. The pores of this circle are irregular in shape and size and are large. Near or between the caudal and median setæ there are usually one or more elongate pores which project in in a striking manner from the circle and which have been given the name of *denticulate* pores. These denticulate pores may or may not indent the membrane of the orifice. Outside of this inner circle of pores and only very slightly separated from them are the six setæ of the anal ring. Outside these setæ and separated by a very narrow margin is the second circle of wax pores or the outer circle of pores. These may be limited cephalad and caudad by the anterior and posterior pairs of setæ or may extend a very short distance beyond them. These pores have a different appearance from the inner circle. They are more regular in shape and arrangement and smaller in size than are the pores of the inner circle. Also they usually have the peculiar appearance of having a light or dark spot in them which undoubtedly is due to refraction.

This in general is a generic description of the anal ring of *Pseudococcus*. The following is a discussion of the specific variations of this ring.

Longispinus Targ.—(Fig. 5). The caudal pair of setæ is nearer the median pair than is the cephalic pair. The outer circle of pores is limited by the caudal and cephalic pairs of setæ and is a single row for its entire length. Projecting from the inner circle of pores at the caudal setæ are two prominent denticulate pores which indent the membrane of the anal orifice.

*The terminology of cephalic and caudal for the ends of the ring is largely one of convenience. The ring is usually on the apex of the abdomen and so the ends would really be dorsal and ventral. However, in the majority of Coccidæ the anal ring is dorsal. According to this terminology the anal ring is assumed to be dorsal also. Thus the closed end of the ring which is usually dorsad of the open end is here spoken of as the cephalic end of the ring.

This circle continues in an irregular single row caudad of the caudal setæ for the usual distance as mentioned in the general description. The anterior concavity of circle is very marked, the posterior lips being prominent. The concavity is formed by a single row of pores for the entire distance.

Citri Risso—(Fig. 4). The cephalic, median, and caudal pairs of setæ are equidistant from each other. The outer circle is limited cephalad by the anterior pair of setæ. Caudad of each posterior setæ is a single pore belonging to the outer circle of pores. Between the caudal and median setæ this row is irregularly double for some distance. The anterior concavity of the circle is not so marked as in the preceding species. The anal orifice is narrower but of the same length as in the preceding species.

Crawii Coq.—(Fig. 3). The relative distance of the pairs of setæ from each other was apparently not constant. Good mounts of this species were difficult to make because of the prominence of the anal lobes. The outer circle is single for the entire distance. In the inner circle the arrangement of the denticulate pores varies slightly. This circle continues caudad of the posterior setæ, in a regular single row for the usual distance. The anterior concavity is not so marked as in either of the preceding species.

Obscurus Essig—(Fig. 2). The caudal pair of setæ are nearer the median pair than is the cephalic pair. The outer circle of pores is single and is limited by the caudal and cephalic setæ. It is single for the entire distance except for a single pore just caudad of the median setæ. In the inner circle at the caudal setæ there are several denticulate pores, the cephalic one indenting the membrane of the orifice. Caudad of the posterior setæ the circle extends in an irregular double row for the usual distance. The anterior concavity is not marked, the concavity being partially filled by pores which form an irregular double row between the cephalic setæ.

Agrifoliae Essig—(Fig. 1). The anal ring is considerably larger than those of the preceding species. The cephalic pair

of setæ is nearer the median pair than is the caudal pair. The outer circle of pores is limited anteriorly by the cephalic setæ. This row extends several pores caudad of the posterior setæ. The row is double between the median and caudal setæ for most of the distance. In the inner circle the number of denticulate pores is irregular. One denticulate pore on each side indents the membrane of the orifice at the caudal setæ. Posteriorly from the caudad setæ the circle continues as a single or double row of pores. The anterior concavity is broad and marked and is composed of a single row of cells.

In the above description the close adherence to the generic type of the ring is noticeable. The specific variation is small, but remarkably constant for the several specimens of each species examined. It is doubtful, however, whether the anal ring will be useful in specific determinations because of the difficulty of making satisfactory mounts. Its usefulness as a generic character appears to be very striking, as it differs greatly from the anal ring of other genera as *Orthezia, Ripersia* and *Pluto.*

POSTANAL SETÆ—(Figs. 1-5)

Ventrad of the anal ring and at varying specific distances from it are two pair of setæ. These setæ have in each case been compared in a number of specimens and their size and arrangement is apparently subject to little variation. Following is a discussion of these setæ.

Longispinus Targ.—(Fig. 5). The cephalic pair* of setæ is separated by a space equal to the diameter of a seta of the anal ring from the caudal horns of the inner circle of wax pores. The setæ of this pair are separated by the width of the orifice. The posterior pair of setæ are separated from the anterior pair by a distance equaling three-fourths the distance of the anterior pair of setæ from the caudal pair of anal setæ. The setæ of the posterior pair are slightly nearer together than are the setæ of the anterior pair. Lines drawn longitudinally through

*For convenience in the discussion the pair of setæ nearest the anal ring is called the cephalic pair of setæ, the other pair then would be the caudal pair of setæ.

the right and left setæ of each pair would form an elongated inverted "V".

Citri Risso—(Fig. 4). The cephalic pair of setæ are separated by a space equal to half their distance apart from the caudal pair of anal setæ. They are from twice to nearly subequal the size of the setæ of the posterior pair. The caudal pair of setæ are separate from the cephalic pair by a distance equalling three-fourths of the distance of the cephalic pair from the caudal pair of anal ring setæ. The setæ of the caudal pair are considerably farther apart than the setæ of the anterior pair. Lines drawn longitudinally through the corresponding right and left setæ of each pair would form a normal inverted "V".

Crawii Coq.—(Fig. 3). The cephalic pair of setæ are separated from the caudal pair of anal setæ by a space equalling two-thirds their distance apart. The caudal pair of setæ are separated from the cephalic pair of setæ by a space equalling three-fourths the distance of the cephalic pair from the caudal pair of anal ring setæ. The setæ of the caudal pair are slightly nearer together than the setæ of the anterior pair. Lines drawn longitudinally through the corresponding right and left setæ of each pair would be parallel. The setæ of each pair are robust.

Obscurus Essig—(Fig. 2). The cephalic pair of setæ are distant from the caudal pair of anal setæ by a space equalling two-thirds their distance apart. The setæ of the cephalic pair are separated from each other by a space equal to the distance apart of the caudal setæ of the anal ring less the width of the base of one anal ring setæ. The caudal pair of setæ are separated from the cephalic pair of setæ by a space equalling one-half the distance of the cephalic pair from the caudal pair of the anal ring setæ. They are smaller than the setæ of the cephalic pair. Lines drawn longitudinally through the corresponding right and left setæ of each pair form a normal "V".

Agrifoliae Essig—(Fig. 1). The setæ of the cephalic pair are separated from each other by a space equal to the distance

between the cephalic setæ of the anal ring. The caudal pair of setæ are separated from the cephalic pair by a space equal to one-half the distance between the caudal pair of setæ. The setæ of the caudal pair are slightly farther apart than are the setæ of the cephalic pair. Lines drawn longitudinally through the corresponding right and left setæ of each pair would form a much elongated inverted "V".

These setæ are believed to be good specific characters. However, their usefulness as specific characters will probably be very limited because of the difficulty of making mounts which will show them in their proper relations.

CERARI—(Figs. 6-17)

The term *cerari* is synonymous with *filuri* (Berlese). A cerari is composed of one or more conical setæ surrounded by a group of wax pores. A conical seta, figs. 6-7, is easily distinguished from the ordinary setæ covering the body. They are broader across the base and distinctly cone-shaped. Different proportioned conical setæ are found in different species, the relation of the width of the base to the length being a specific variation. The wax pores of the cerari are of the usual triangular type covering the body. The cerari occur slightly dorsad of the margin of the body. There are seventeen pairs in each of the species studied. The number of cerari for each body segment was studied, but no definite conclusions reached. Berlese in his study of *longispinus* Targ. assigns five cerari to the head, one to the prothorax, two to the mesothorax, two to the metathorax and one each for the seven abdominal segments. To solve definitely this problem the segmentation will have to be followed from the first nymphal stage.

The number of conical setæ and the grouping and number of the wax pores is a fairly constant specific character. There is a marked specific variation which, however, is well within the limits of the generic variation.

So far as known to the writer, the cerari have never been used in taxonomy or mentioned in descriptions of species of the subfamily Eriococcinæ. The following is a description of the cerari

Cerari		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Specimen	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
I	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
II	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
III	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IV	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
V	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VI	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VII	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VIII	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IX	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
X	rt	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table I. *P. citri* Risso. Number of conical setæ in each cerari.

Cerari		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Specimen	vt		3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
I	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
II	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
III	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
IV	lft	3	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
V	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VI	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VII	lft	3	4		2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VIII	lft	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
IX	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	vt	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
X	lft	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2

Table II. *P. obscurus* Essig. Number of conical setæ in each cerari.

of each of the five species studied. The cerari are numbered from the head caudad. The measurements given do not include the base of the conical setæ. The diameter being taken just above the collar-like base and the length being taken from the base to the apex of the setæ.

Citri Risso—(Figs. 10-11, Table I). An examination of Table I shows that the number of conical setæ is two for each cerari and that this number is constant in all the specimens tabulated. Fig. 10 shows a camera lucida drawing of the first cerari. It will be seen from this figure that the number of wax pores is very few compared to the head cerari of some of the other species. This small number of wax pores is a constant specific character. In a large number of species examined the arrangement of the wax pores and setæ varies but slightly from the figure. Cerari 2-16 resemble very closely this figure. The conical setæ of the first cerari are 17-19 microns long and 4.2-4.8 microns in diameter. Fig. II shows the anal cerari. The bases of the conical setæ are one-third larger than those of the head cerari. There are but few pores as in the first cerari. The two conical setæ of each cerari are subequal in size. Two smaller setæ are seen near the cerari. The conical setæ of the anal lobes are 21-24 microns long and 5-6 microns in diameter.

Obscurus Essig—(Figs. 14-15, Table II). Fig. 14 shows the first cerari of this species. The conical setæ are slightly larger than those of the preceding species. The wax pores are arranged thickly. There are three conical setæ in this cerari, a constant character. The number of conical setæ in the second cerari varies from two to four; four is the usual number. The fourth and fifth cerari each have two conical setæ. The sixth cerari has three conical setæ. The cerari caudad of the sixth each have two conical setæ. The conical setæ of the first cerari are 9-10 microns long and 3.5-4.2 microns broad.

Fig. 15 shows the cerari of the anal lobes. The large number of wax pores is noticeable. The caudal conical setæ of the cerari is noticably larger than the cephalic one. The length of the conical setæ varies from 28-32 microns and the diameter 8-10 microns.

Agrifoliae Essig—(Figs. 8-9, Table III). Fig. 9 shows the first cerari. The diameters of the bases of the conical setæ are subequal to those of the preceding species. The number of wax pores is very much less than in the preceding species, approaching the condition found in *citri* Risso. There are three conical setæ in this cerari. Three ordinary setæ are also seen in the cerari. There are two to four conical setæ in the second cerari; two to three in the third cerari, usually three; two to three in the fourth and fifth cerari, usually two; caudad of the sixth each cerari has two conical setæ. The conical setæ of the first cerari are 14-16 microns long and 4-5 microns broad.

Fig. 8 shows a cerari of the anal lobe. The bases of the conical setæ are the largest of any species studied. The posterior conical seta is noticeably larger than the anterior. The number of wax pores is about the same as in *obscurus* Essig, but they are much less crowded together and cover a larger space. Eight ordinary setæ are seen near the cerari. The anterior conical seta is 27-29 microns long and 9-10 microns in diameter. The posterior conical seta is 30-32 microns long and 11-12 microns in diameter.

Longispinus Targ.—(Figs. 6, 16, 17, Table IV). Fig. 16 shows the first cerari of this species. The size of the bases of the conical setæ is two-thirds that of *citri* Risso. There are usually three conical setæ in this cerari, very seldom four. There are many wax pores and these are crowded together. Four ordinary setæ are seen in the cerari. The second cerari has 3-4 conical setæ, usually four; the third cerari has two conical setæ; the sixth has three conical setæ; the cerari caudad of this have two conical setæ. The conical setæ of the first cerari are 2.6-3.5 microns in diameter and 11-12 microns long.

Fig. 17 shows a cerari of the anal lobes. The conical setæ are subequal in size to those of *obscurus* Essig. The posterior conical seta is strikingly larger than the anterior one. The wax pores are many and crowded together. Four ordinary setæ are seen near or in the cerari. The anterior conical seta is 22-25 microns long and 8-9 microns in diameter. The posterior one is 27-30 microns long and 10-11 microns in diameter.

Cerari		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Specimen																		
I	vr	3	2						2	2	2	2	2	2	2	2	2	2
	lft	3	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2
II	vr													2	2	2	2	2
	lft	3	4	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2
III	vr	3	3	3	2	2	4	2	2	2				2	2	2	2	2
	lft	3	3	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2
IV	vr	3	4	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	2	3	2	2	3	3	2	2		2	2	2	2	2	2	2
V	vr	3	2	3	2	2	3	2	3	2	2	2	2	2	2	2	2	2
	lft	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
VI	vr	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	lft	3	3	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2

Table III. *P. agrifoliæ* Essig. Number of conical setæ in each cerari.

Cerari		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Specimen																		
I	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	3	3	2	2	2	2	2	2	2	2	2	2	2
II	vr	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	4	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
III	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
IV	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
V	vr	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VI	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VII	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
VIII	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	4	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
IX	vr	3	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
X	vr	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2
	lft	3	4	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2

Table IV. *P. longispinus* Targ. Number of conical setæ in each cerari.

Crawii Coq.—(Figs. 7, 12, 13, Table V). Fig. 12 shows the first cerari. The wax pores are few and scattered. The number of conical setæ varies from four to seven, usually more than four; the second and third cerari have 4-8 conical setæ, usually more than four; the fourth cerari has 5-8 conical setæ; the sixth cerari has 5-7 conical setæ; the seventh cerari 4-7 conical setæ; the eighth cerari has 1-4 conical setæ, usually 2-3. The cerari caudad of the eighth and to the seventeenth usually have 7-8 conical setæ. The anal cerari has from 11-19 conical setæ, usually 13-15.

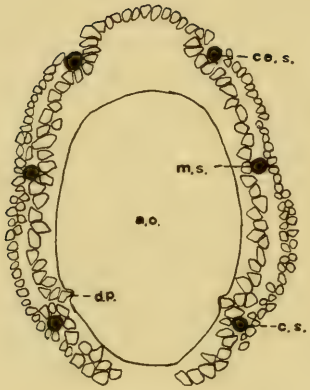
Fig. 13 shows an anal cerari. The bases of the conical setæ are seen to be but little larger than in the first cerari. The number of wax pores is large, but the arrangement is scattering. The space covered by the cerari is much greater than in any other species studied, usually covering most of the dorsum of the anal lobe. Five robust ordinary setæ of the first cerari are 4-5 microns in diameter and 23-25 microns long. The conical setæ of the anal cerari are 5-6 microns in diameter and 28-30 microns long. The most striking character of this species is the large number of conical setæ in the cerari.

The above discussion shows that the cerari as specific characters are very promising. The conical setæ are easily seen and counted in ordinary mounts. When the seta is broken off the base can easily be distinguished. The grouping of the wax pores is a distinctive specific character. It is believed that the character of the cerari will be very useful in the formation of analytical tables and the identification of species.

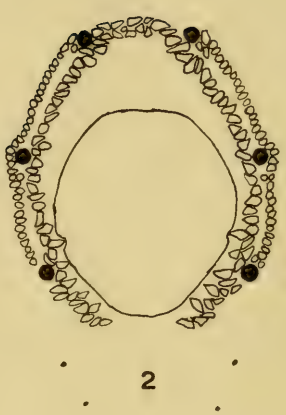
Berkeley, California, March, 1913.

Cerari		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Specimen	vt.	5	7	8	2	5	5		3	5		6	5	5	6	7	8	18
I	lft.	5	7	2	6	5	7		2	3.	5	6	6	5	6		7	15
II	vt	5	5	7	2	6	5	6	2	4	6	5	5	5	6	8	7	12
	lft	5	6	5	3	5	5	6	2	4	6	5	5	7	5	6		11
III	vt	5	6	8	2	6	6	6	3	5	4	5	5	5	4		6	16
	lft	5	5	7	2	6	5	7	3	5	5	5	6	5	6	7	7	14
IV	vt	6	5	6	2	6	6	7	3	5	6	5	5	5	5	6	7	14
	lft	6	6	4	3	8	6	7	3	6	5	5	5	6	7	6	6	17
V	vt	6	5	7	3	8	7	5	3	5	6	5	5	5	6	7	7	13
	lft	6	8	9	3	8	7	6	3	5	5	2	5	4	5	7	8	13
VI	vt	5	6	8	2	7	5	5	1	5	7	5	5	4	6	7	8	13
	lft	5	6	6	3	5	5	6	4	3	6	6	5	5	6	7	6	13
VII	vt	4	5	5	2	5	7	7	1	4	6	5	4	5	6	5	6	14
	lft	4	4	6	2	5	6	6	3	4	5	5	5	5	6	6	8	15
VIII	vt	6	8	7	2	6	5	5	3	5	6	5	7	6	8	8	7	12
	lft	6	7		2		5	6	4	4	6	4	6	5	5	7	5	13
IX	vt	5	7	6	2	6	7	5	3	4	7	6	4	5	7	8	7	15
	lft	5	7	7	2	6	7	4	4	4	7	4	5	5	4	6	7	14
X	vt	6	3	7	2	6	5	6	3	5	5	5	5	5	6	7	7	14
	lft	7	6	7	3	6	5	5	3	5	5	5	6	7	6	7	7	11

Table V. *P. crawii* Coq. Number of conical setæ in each cerari



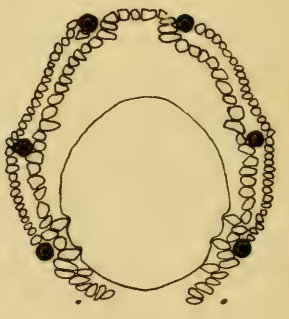
1



2

ce. p. s.

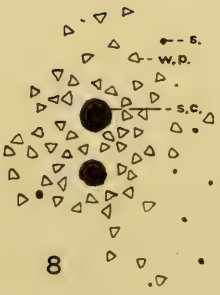
c. p. s.



5

6

s.
w.p.
s.c.



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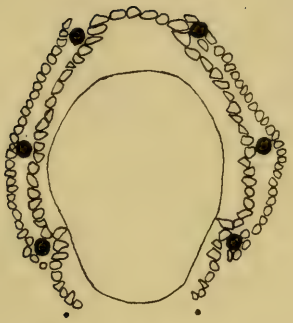

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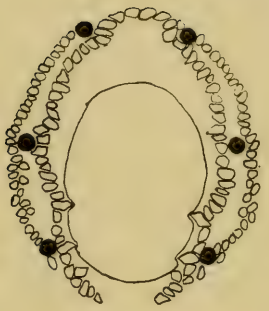

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13

14

16

11

12

15

17

EXPLANATION OF FIGURES

ABBREVIATIONS

a.o.—Anal orifice.
ce.p.s.—Cephalic pair of postanal setæ.
ce.s.—Cephalic pair of anal setæ.
c.p.s.—Caudal pair of anal setæ.
d.p.—Denticulate wax pore.
m.s.—Middle pair of anal setæ.
s.—Ordinary setæ.
s.c.—Setæ of conical type.
w.p.—Triangular type of wax pore.

All figures are drawn with a camera lucida, x660.

Figure 1. The anal ring of *P. agrifoliae* Essig. In this and the succeeding figures of anal rings the cephalic end of the ring faces the top of the page.
Figure 2. Anal ring of *P. obscurus* Essig.
Figure 3. Anal ring of *P. crawii* Coq.
Figure 4. Anal ring of *P. citri* Risso.
Figure 5. Anal ring of *P. longispinus* Targ.
Figure 6. Lateral view of the posterior conical seta of an anal cerari of *P. longispinus.*
Figure 7. Lateral view of conical seta of an anal cerari of *P. crawii.*
Figure 8. Surface view of an anal cerari of *P. agrifoliae.*
Figure 9. Head or first cerari of *P. agrifoliae.*
Figure 10. First or head cerari of *P. citri.*
Figure 11. Anal cerari of *P. citri.*
Figure 12. Head cerari of *P. crawii.*
Figure 13. Anal cerari of *P. crawii.*
Figure 14. Head cerari of *P. obscurus.*
Figure 15. Anal cerari of *P. obscurus.*
Figure 16. Head cerari of *P. longispinus.*
Figure 17. Anal cerari of *P. longispinus.*

The Yerba Santa Mealy Bug

(Pseudococcus yerba-santae n sp.)

E. O. ESSIG

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FEMALES

General Appearance.—(Fig. 1) The general outward appearance, including size, shape, color and vestiture, furnishes the only reliable data for the recognition and description of mealy bugs. The species under discussion does not differ from the other known species to a great degree, but enough so to warrant its being considered new to science. The size is average,

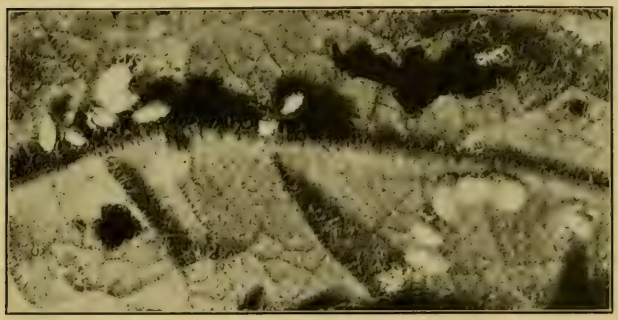

Figure 1. The yerba santa mealy bug (*Pseudococcus yerba santæ* n sp.) Slightly enlarged. (Original.)

being from 1.8 mm. to 2.2 mm. in length and nearly half as wide. The shape is oval oblong, being slightly narrower than the typical mealy bugs. The body color is light or pinkish. The contents of the bodies are easily removed by boiling in KOH, the skin becoming colorless and transparent—the legs and antennæ remaining amber. The white waxy covering is just thick enough to hide the body color and appears velvety. The segmentation of the body is usually plainly visible. The wax filaments around the

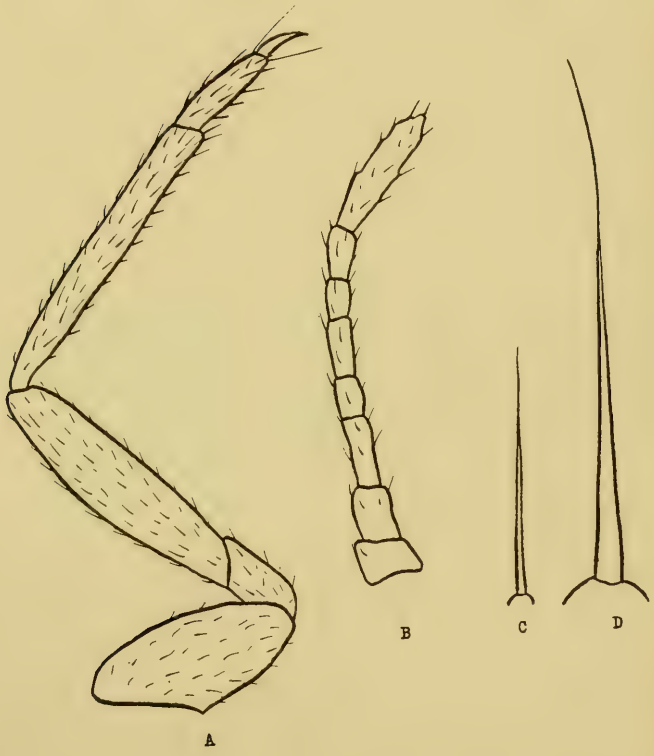

Figure 2

edges are very short—those behind being longest, but even these are scarcely noticeable.

The eggs are yellow and laid in small egg-sacs which envelope the female bodies.

Body Characters.—Antennae.—(Fig. 2, B) The antennæ are normally eight-segmented with little variation to the lengths of the respective articles. The formula, beginning with the longest article, is 8, 3 (2, 5), 7, 6, 3, 1. 1 is often slightly longer than 3 or 6 and 6 longer than 3. To the mind of the writer little can be relied upon the antennal segmentation as a means of classification, excepting in a few instances. They are light brown in color. *Legs.*—The legs are well developed with the hind pair considerably larger than the first two. They are slightly hairy and light brown. The coxæ (Fig. 2, A) are large—being twice as long as the trochanters. The femora do not attain the greatest width of the coxæ and are slightly shorter than the tibiæ. The tarsi are about one-third as long as the tibiæ. The claws are well developed. *Spines.*—Fig. 2, C and D) The spines of the anal lobes are nearly twice as long as the circumanal spines.

Host Plant.—This species feeds upon the foliage of the Yerba Santa or Mountain Balm (*Eriodictyon californicum* (H. & A.)); many of the plants were completely covered with the young and adult females and the egg-sacs. No adult males or their cocoons were collected.

Locality.—Though the Yerba Santa is exceedingly common throughout the southern part of the state, this mealy bug has been found to infest it only in the Sespe Canyon, Ventura County, California. In this locality the infestation is general and often severe.

Natural Enemies.—Two dipterous insects play a very important role in reducing the numbers of this mealy bug. The larvæ of the syrphid fly (*Baccha lemur* O. S.) preys upon the eggs and young, and the small internal parasite (*Leucopis bella* Loew.) works upon the half-grown and adult females.

Date of Collection.—This species was collected May 11, 1911. My brother, S. H. Essig, shares in its discovery.

The Circulatory System of Laila Cockerelli

MABEL GUERNSEY

Laila cockerelli is the single species of a genus of Doridida described by MacFarland in 1905. Since it is very abundant at Laguna Beach, I undertook a study of the anatomy, of which this paper, on the circulatory system, is a part. Most of the specimens with which I worked were fixed with chrome-acetic acid for sectioning, as the small size of the animal, the length of which ranged from 10 to 15 mm., made dissection unsatisfactory.

The only part of the circulatory system which it was convenient to dissect was the heart. This is situated close beneath the upper body wall, just anterior to the branchiæ, and in the living animal its pulsations may sometimes be seen through the skin. The heart consists of an oval or nearly circular, flattish ventricle and a very large, thin-walled auricle, both enclosed in a delicate pericardium. The ventricle contains many interlacing muscle-fibres, which form a network between the walls, so that the contracted ventricle appears as a thick mass of muscle-fibres. Between the auricle and ventricle, circularly placed muscle-fibres form a valve. The walls of the auricle are extremely thin, consisting of a delicate sheet of connective tissue, strengthened by a very few bands of muscle-fibres. The enclosing pericardium is thin, but thicker than the wall of the auricle, and contains numerous nuclei.

Since dissection or injection was very difficult, the course of the circulation was determined by making a graphic reconstruction from serial sections. The drawing was from a reduction of this reconstruction. The reconstruction of the arterial circulation was made from a smaller animal than that of the venous circulation, and is consequently drawn to a different scale. This was done because the arterial system was imperfectly preserved in the specimen that showed the venous system to best advantage. No attempt was made to reconstruct the pedal sinuses, which are a complex, interlacing mass, reminding one of the interstices of a sponge. The arterial circulation was especially difficult to

make out, owing to the extreme thinness of the walls of the arteries, which were usually collapsed, misplaced, or torn in places, so as to make their identification difficult. Consequently, only the main branches of the arterial circulation are shown in the drawing.

The aorta leaves the ventricle at its anterior end, on the lower side. Almost immediately it divides into two parts, the posterior and anterior aortæ. The posterior aorta runs back over the liver, dividing very soon into two parts, which branch and rebranch, the branches soon becoming indistinguishable from clefts between the liver lobes. The anterior aorta runs forward below the upper body-wall and passes through the blood gland, which spreads in a flat, thin sheet above and posterior to the buccal mass. It is divided into a right and left portion and these are subdivided into numerous lobes. The substance of the gland is somewhat similar in its appearance to the pulp of lymph glands in vertebrates, as it consists of a mass of cells, among which are a few interlacing fibres. It communicates with the aorta by several branches. The aorta now divides into three parts. The first, the genital artery, runs down to the reproductive organs, where it opens into a network of sinuses; the second (N) runs through the blood gland and along the upper surface of the capsule surrounding the central ganglia; the third branch, or aorta proper, goes down on the right side of the buccal mass, curves under it, and gives off a large buccal artery, which sends two branches to the sinuses in the buccal mass. The remainder of the aorta enters the foot muscles as the pedal artery (Q), which can be traced forwards for some distance, but which I have been unable to trace backwards, although it probably has branches which run backwards. In any case, the blood would be carried back by the sinuses of the foot.

The venous blood, with the exception of that coming from the posterior aorta, circulates through an elaborate system of irregular, intercommunicating sinuses, chiefly in the foot and sides, which communicate with the main body cavity and the great lateral sinus. This lateral sinus forms a ring around the body at the level of the origin of the papillæ, to which it gives branches.

Figure 1. Heart and venous system, X22. A, visceral vein; B, afferent; C, efferent branchial vein; D, communication between branchiæ and auricle; E, aorta; F, rhinophore vein; G, communication between body cavity and lateral sinus; H, direct communication with pedal sinuses.

Figure 2. Arterial system, X44. J, posterior; K, anterior branch of aorta; L, artery to reproductive organs; M, artery from blood gland to aorta; N, artery to ganglia; O, P, buccal arteries; Q, pedal artery.

It communicates with the main body cavity at a point on either side just anterior to the rhinophores (G), and with the pedal sinus complex at numerous points (H), the main ones being at the head and tail, and just anterior and posterior to the opening into the auricle. It also gives off many short and long branches, above and below, as well as branches to the papillæ.

The aeration of this blood is undoubtedly accomplished through the skin of the back and sides, to which branches of the sinuses are closely applied and through the papillæ, which seem especially adapted for this purpose. The sinuses in the papillæ are much dilated at the ends, and communicate by many fine branches with the spongy network of which the substance of the papillæ is composed, so that the blood is brought in close contact with the epithelium covering the surface. Also, when the animal is alive, the papillæ are in constant slow motion, which would facilitate aeration of the blood.

The lateral sinus opens directly into the auricle by short branches, and the blood is then immediately returned into circulation without passing through the branchiæ. The blood from the posterior aorta follows a different course from the rest. After passing through a complex mass of sinuses between the liver lobes, it is collected in venous channels that come together in a great sinus running along just above the stomach, from which it is carried to the branchiæ by the hepatic vein (A). This gives a single vein to each branchial plume. These run up the posterior side of the main trunk of the plumes and send off branches which, running forward close under the epithelium, are collected in veins (C') which run down the anterior trunk of each plume. These veins are collected into a single one which opens almost immediately into the auricle, thus returning the branchial blood to the circulation, where it is mixed with blood from the lateral sinuses.

The branchiæ usually consist of three plumes, but there may be five, the number which MacFarland has described as typical. These have a muscular central stalk with several branches, which rebranch into fine ultimate endings. Each branchial plume receives a large nerve from the branchial plexus, and a branch

from the hepatic vein. The branches of this vein are separated from the surface only by a very thin, columnar epithelium. Clumps of gland cells are found at the ends of the plumes just beneath the sinuses, and scattered mucous cells are occasionally seen in the epithelium.

The arteries are large tubes with a thin, muscular wall. The larger sinuses have a thin homogeneous wall of connective tissue and, in the lateral sinuses, muscular fibres are sometimes present, but the smaller sinuses seem to have no wall, being merely clefts in the connective tissue.

The circulatory system does not possess any striking differences from the type found in Doris by Hancock and Embleton, excepting for the special arrangement for the papillæ, which were not found in any of the forms they described.

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Proc. biol. soc. Wash. Vol. XVIII, pp. 35-54.

(Contribution from the Zoological Laboratory of Pomona College.)

Nerve Cells of Tarantula

WILLIAM A. HILTON

G. Saint Remy '90 and others have indicated at least two sizes of cells in the nervous systems of spiders. In tarantula there are numerous cells of small size and fewer of a larger sort. The functional nerve elements may be told from the others by their rather clear nuclei which contain prominent nucleoli. The large cell-bodies as compared with the size of the nuclei are also characteristic. No neuroblasts were clearly recognized in the adult spider. Two types of elements were seen which were thought to be connective in their nature, or neuroglia cells. In one kind of these the nuclei were rather clear, the cells widely scattered, but often partly joined together by their long slender processes. Some of these were found in the fibrous portion of the ganglion. In the other type of supportive element the cells are massed together in certain regions, the nuclei are filled with granules of chromatin and fine strands from the cytoplasm extend between the adjoining cells and penetrate into the fibrous area. These two types of elements form a framework or reticulum for the cells and fibers of the nervous system (Fig. 1, D and E).

The smaller nerve cells seem to be rather simple for the most part. They appear to be unipolar with a large process directed towards the central fibrous mass of the ganglion. The nuclei of these are large with large nucleoli which contain one or more refractive spots. Fibrils are not so easily determined as in larger cells, but the nerve processes seem to be composed of many fine fibrillæ. Little was learned about other points in the finer structure of these cells, but in preparations fixed in Flemming's fluid there were numerous dark masses which were often seen. These were usually found in the cytoplasm on the opposite side of the cell from the nerve process. In appearance these resembled blackened fat particles (Fig. 1, C).

The larger nerve cells were found grouped together or scattered about in the more ventral regions of the nervous system; some were found in the supraesophageal region, on the lateral

sides and also dorsally. The groups of larger cells were often surrounded by many others, both of the neuroglia type and of the smaller nerve cell form. In the largest neurones, as in the smaller ones, the nuclei are prominent with marked nucleoli which have one or more dark areas in them. Surrounding the nucleus there is a fine meshwork or cell reticulum upon which granules of tigroid substance may be seen. This material is in the form of fine granules in some cells, in others it is com-

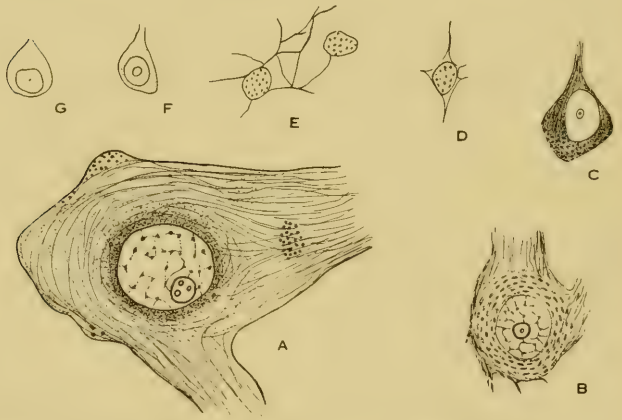

Figure 1. Cells from the central nervous system of spiders, X800. A to E, cells from tarantula; D and E, supporting cells; F, nerve cell from a spider 1½ mm. long; G, nerve cell or neuroblast from a young spider of about 1½ mm. length.

posed of coarser flakes. Running through the meshwork of the cell with its tigroid substance delicate continuous strands or neuro-fibrillæ may be seen and traced from the region of the nucleus into branches of the nerve cell. Adjacent cells may be seen to be in some communication with each other by means of these fine fibrillæ. Broader connections between cells such as Haller '04 and Hilton '11 have recorded in insects seem to occur in this form to a limited degree (Fig. 1, A and B).

The magnitude of nerve cells in many forms seems to depend upon the number and extent of the processes. The size of the animal ought then to make a difference with that of the cells. In one of the Collembola recently studied, the animal was about 1.5 mm. in length; the cells were about .002 mm. in diameter. In a large tarantula, one of 6 cm. body length, the nerve cells were of several sizes. Some were .05 mm. by .03 mm. The smallest were about .02 by .015 mm. In a small spider of 1.5 mm. length, the largest cells were less than .01 mm. in diameter (Fig. 1, F), while a young drassid of 1.5 mm. which was active but not mature, had nerve cells of about the same size (Fig. 1, G). The cells in the last case appeared much like neuroblasts.

The smallest functional nerve cells in the tarantula were a little larger than the neuroblasts of young forms, while the functional cells of a more mature spider were about the same size as these neuroblasts. The largest nerve cells of tarantula as compared with the largest of a small spider show the greatest contrast.

In a consideration of the size of nerve cells in various animals it seems clear that although the larger organisms have the larger nerve cells, there are other factors than size of the animal and consequent length of the cell processes which determine the magnitude of the neurones.

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(Contribution from the Zoological Laboratory of Pomona College.)

New Californian Microlepidoptera

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The species of Microlepidoptera, described in the following, were received for determination from Mr. W. S. Wright, San Diego, California, together with some fifty other species, which I have recognized as already described.

If a few more equally valuable collections could be obtained from California this coming season, the writer would be pleased to fulfil his promise to Dr. C. F. Baker, to give a comprehensive paper on the known California Microlepidoptera for this Journal. I shall be glad to hear from other collectors of these insects in California.

Coleophora quadristrigella new species

Labial palpi long, porrected, smooth; second joint hardly thickened; white, shaded with light brown externally. Antennæ white, somewhat thickened with scales toward the base; basal joint yellow, somewhat enlarged, but without projecting flap of scales. Face, head and thorax light yellow with the cheeks, patagina and posterior tip of thorax white. Forewings with silvery white ground color; from base to apex along the upper edge of the cell and covering vein 7 runs a broad longitudinal streak of light golden yellow, which at basal fourth gives off a narrower longitudinal branch of the same color, which terminates on the middle of the termen; below the fold from base to tornus runs a third longitudinal yellow streak; these yellow streaks leave the white ground color exposed only as four longitudinal streaks, one along the costal edge, one along the dorsal edge, one on the fold and one from basal third of the cell to close below apex. Cilia whitish fuscous. Hind wings light fuscous with the cilia a shade darker. Abdomen light fuscous with golden lateral edges. Legs whitish hairs on posterior tibiæ golden.

Alar expanse: 18-20 mm.

Habitat—San Diego, California, June, July. W. S. Wright, coll.

U. S. N. M. Type No. 15,607.

Coleophora entoloma new species

Very close to *C. quadristrigella,* but smaller and with the yellow color somewhat darker and occupying the larger part of the wing, leaving the white color as three thin longitudinal streaks, one along the costal edge, one through the middle of the wing to apex and one on the fold; the fourth white streak found in *quadristrigella* on the dorsal margin is absent in the present species, the subplical yellow longitudinal streak being broader and includes the dorsal edge. No other colorational differences.

Alar expanse: 15-18 mm.

Habitat—San Diego, California, May, June. W. S. Wright, coll.

U. S. N. M. Type No. 15,608.

Galechia coticola new species

Labial palpi light ochreous with extreme base dark brown and with a few scattered brown scales on terminal joint; second joint with well developed compressed and furrowed tuft. Antennæ black. Face, head and thorax light golden yellow. Patagina purplish black. Forewings with costal half blackish brown with a purple tint; dorsal half golden yellow; the dividing line between the two colors is nearly straight from base to the middle of termen except for a large triangular process of the yellow color into the dark color on the middle of the wing; in the dark costal area lies a short, oblong, yellow dash below the costal edge at basal third and a larger triangular costal spot at apical fourth; cilia fuscous. Hindwings light fuscous. Abdomen light yellow dusted with dark brown. Legs yellowish with broad dark brown annulations on tibiæ and tarsi, except on the hind tarsi, which are all yellow.

Alar expanse: 16-17 mm.

Habitat—La Puerta, California, July. Wright & Field, coll.

U. S. N. M. Type No. 15,609.

A well marked species nearest in coloration to *Gelechia kinkaidella* Busck, but easily distinguished by the pattern, which comes nearer to that of the much smaller *Gelechia paraplutella* Busck.

Gelechia scabrella new species

Labial palpi with short indistinctly divided brush on the underside, blackish brown exteriorly, gray on the inner side; terminal joint shorter than second somewhat thickened with scales, blackish brown with an indistinct pale annulation at base. Antennæ finely pubescent, dark purplish brown each joint terminating in a circlet of paler somewhat raised scales. Face, head and thorax dark purplish brown finely irrorated with white, the extreme tip of each scale being white; posterior tip of thorax deep velvety, unmixed brown with a strong purple sheen. Forewings of the same irrorated brown color as the thorax except for a large triangular dorsal patch near the base, which has the same color as the posterior tip of thorax; this reaches with one corner to the costal edge and is sharply edged posteriorly by a thin oblique white line; on the middle of the wing is a similarly unicolored, but more diffused larger patch, edged posteriorly by a thin, transverse, slightly concave, white line across the wing at apical third; both of these dark brown areas contain small tufts of raised scales in two longitudinal rows; the groundcolor with lighter brown white-tipped scales thus cover the extreme base, an oblique fascia beyond the first white line the dorsal and costal edges and the entire tip of the wing beyond the thin white fascia; cilia concolorous. Hindwings broader than the forewings, light shiny fuscous. Abdomen light fuscous. Legs blackish fuscous with indistinct narrow annulations at the joints.

Alar expanse: 17-20 mm.

Habitat—San Diego, California, June, July. W. S. Wright, coll.

U. S. N. M. Type No. 15,610.

This is the western representative of our eastern *G. walsing-*

hami Dietz, to which it comes quite close, though much larger and deeper in color.

The species has a striking superficial resemblance to the larger typical species of the genus *Gnorimoschema.*

Gelechia bigella new species

Labial palpi with stubby, indistinctly furrowed brush on second joint, nearly even throughout its length light fuscous mottled with dark brown. Face light fuscous. Head and thorax dark fuscous. Forewings dark velvety fuscous with two velvety black round dots, one on the middle of the fold and one obliquely above it on the cell, both slightly edged with rust-brown scales; at the end of the cell is a small rust-brown spot containing a few single black scales, a small blackish costal spot at apical third and an illdefined marginal row of black around the apical and terminal edges; cilia fuscous sprinkled with single black scales. Hindwing dark fuscous; anal cilia yellowish fuscous; the males have on the underside of the hindwing a row of long raised scales on vein 8. Abdomen dark fuscous, with the upper side of the basal joints tinged with golden yellow. Legs blackish fuscous with narrow yellowish tarsal annulations.

Alar expanse: 20-21 mm.

Habitat—San Diego, California, February. W. S. Wright, coll.

U. S. N. M. Type No. 15,611.

Nearest to our Eastern *Gelechia binimaculella* Chambers.

Ethmia mediella new species

Labial palpi long, recurved, reaching beyond vertex; white sprinkled with black scales; outer side of second joint nearly all black. Antennæ leadcolored with narrow white annulations; first joint white on the underside. Face white. Head white with a central black spot. Thorax white with four black dots, two on each side. Patagina white with two black basal dots. Forewings white suffused with soft gray which is darker just above the fold below which there is a rather sharply edged pure white longitudinal area; basal part of costal edge dark lead

colored; on the fold is a longitudinal row of three deep black lines and at the end of the cell is a pure white dot edged by short black dashes; around apical and terminal edge is a series of short black streaks. Cilia white. Hindwings dark gray with the anal area yellow and cilia yellow. Abdomen light golden yellow except the upper side of the first joint, which is gray. Legs white with well marked black tarsal annulations and with posterior tibiæ yellow.

Alar expanse: 22-26 mm.

Habitat—San Diego, California, June, July. W. S. Wright, coll.

U. S. N. M. Type No. 15,612.

Closely related and very similar in pattern to *Ethmia arctostaphylella* Walsingham and *Ethmia obscurella* Beutenmuller, but much lighter than these species in color.

Semioscopis acertella new species

Labial palpi black with the tips of both joints and a sprinkling on second joint white. Head and thorax brownish fuscous. Forewings with the groundcolor bluish-white but so heavily overlaid with dark brownish fuscous that the white only appears in irregular longitudinal thin lines; the brown faintly outlines the venation and is mixed with black scales, also arranged in illdefined and interrupted longitudinal lines; on the middle of the cell is a broader white longitudinal line, edged above and below and broken in the middle by short deep black lines; on the middle of the fold is a short black longitudinal streak. The effect to the unaided eye is a pepper and salt coloration with a narrow white central streak on the cell. Hindwing dark fuscous with whitish area. Abdomen yellowish fuscous. Legs black with yellowish annulations on tibiæ and tarsi.

Alar expanse: 16-19 mm.

Habitat—San Diego, California, November. W. S. Wright, coll.

U. S. N. M. Type No. 15,613.

Nearest in wing form and pattern to *Semioscopis megamicrella* Dyar, but smaller, much darker and suffused in its marking and without the well marked terminal row of black dots.

Hypoplesia dietziella new species

Tongue and maxillary palpi obsolete. Labial palpi rather long curved ascending; second joint with well developed brush on the underside and with several long black bristles along the upper edge; terminal joint shorter than second, bluntly pointed; blackish fuscous with extreme tip of the third joint yellowish. Antennæ nearly as long as the forewings, stout, with short whorls of raised scales, less so in the females; basal joint with pecten yellowish fuscous, lighter toward the tip. Face and head rough with long, erect dark fuscous hair scales. Thorax dark fuscous. Patagina tipped with yellow. Forewings dark fuscous mottled with black and yellow in indistinct and transverse striation; the black scales are slightly raised and most prominent; along the costal edge is a series of small black dots and at the end of the cell is a larger ill-defined black spot; around the entire edge from the middle of costa to tornus is a series of small yellowish dashes also present in the otherwise dark fuscous cilia. Hindwings shining dark fuscous. Abdomen dark fuscous. Legs black with yellowish annulations. Hindlegs rather long with the tibiæ hairy.

Alar expanse: 16-20 mm.

Habitat—San Diego, California, June, July. W. S. Wright, coll.

U. S. N. M. Type No. 15,614.

I take pleasure in associating the name of my friend and colleague, Dr. Wm. Dietz, with this interesting species, the second one known in the genus originally characterized by him under the preoccupied name, *Paraplesia*. (Trans. Am. Ent. Soc. XXXI, p. 12, 1905)=*Hypoplesia* (Busck, Proc. U. S. Nat. Mus. XXX, p. 735, 1906.)

The original description is rather scanty and partly incorrect; the antennæ are not bipectenate, but are thickened with whorls of raised scales. Their length and the absence of tongue

and maxillary palpi are the significant characters. The venation is simple, all the veins separate (not 7 and 8 out of 9 as stated by Dietz) in both wings; vein 7 to costa in the forewing. The genus is closely allied to *Hapsifera* Zeller and *Euplacamus* Latrielle, both of which, however, have veins 7 and 8 stalked in the forewing.

Some New Genera and Species of Chalcidoid Hymenoptera of the Family Eulophidæ From Australia

A. A. GIRAULT

Family EULOPHIDÆ
Subfamily TETRASTICHINÆ, TETRASTICHINI

Neomphaloides new genus

Female—Head normal, nearly round from direct cephalic aspect, the antennæ inserted near its middle, distinctly above an imaginary line drawn between the ventral ends of the eyes, eleven-jointed-scape, pedicel, three narrow ring-joints, three funicle joints and a three-jointed club, the terminal joint ending in a spur. Funicle joints elongate, the proximal one nearly as long as the club; pedicel very long, subequal to the distal funicle joint. Fore wings ample, the marginal and submarginal veins long, the former about a fourth longer than the latter; postmarginal vein absent; stigma vein with a slender neck. Both wings normally ciliate, the marginal cilia short. Tarsi four-jointed, the tibial spurs single. Both mandibles tridentate. Parapsidal furrows complete. Scutellum with four longitudinal grooved lines, the lateral ones finer; metathoracic spiracle large, oval. Propodeum with two, short median carinæ, parallel but distad diverging suddenly and running along the distal margin of the segment. Abdomen sessile, longer than the head and thorax combined, produced ventrad near base, conic-ovate, produced distad into a moderately long stylus from beneath which slightly projects the ovipositor enclosed by its valves. Mesoscutum long, with a distinct median groove. Sculpture fine reticulation over the head, thorax and abdomen, not varying noticeably as regards density. Body metallic. Ocelli distant from the eyes. Genal sulcus distinct.

Male—Not known.

A genus unique for the tribe because of the three ring-joints of the antennæ, the longitudinal grooves on the thorax and the pro-

duced abdomen. Resembling *Tetrastichus* Haliday but the abdomen much longer.

Type—The following species.

1. *Neomphaloides cinctiventris* new species.

Female—Length 3.75 mm. General color dark metallic green, the propodeum brighter, the mesothorax with much bronze, the abdomen darker, above at base with a broad orange band which ventrad spreads further distad and involves the produced part of the venter; legs wholly light lemon yellow as are also the ventral half of the occiput and the face ventrad of the insertions of the antennæ; also the cheeks. Scape and pedicel brownish, the former with more or less black dorsad; remainder of antenna black. Tegulæ and venation more or less lemon yellowish, the wings hyaline. Proximal joint of antennal club only about two-thirds the length of the distal funicle joint and about a fourth longer than the second club joint, the distal club joint very short, terminating in a short, spur-like seta. Scape long, reaching to the ocelli. Vertex yellowish along the eye margin, dorsal aspect.

(From 2 specimens, 2-3-inch objective, 1-inch optic, Bausch and Lomb.)

Male—Unknown.

Described from two female specimens received for study from Mr. C. French, Jr., Acting Government Entomologist, Melbourne, Victoria, labelled "Parasitic on homopterus gall on Eucalyptus, Cook's River, Sydney."

Habitat—Australia—Sydney, New South Wales.

Types—No. Hy 1197, Queensland Museum, Brisbane, the above specimens on tags (2 pins) plus a slide bearing a head.

Tribe OMPHALINI

Selitrichodes new genus

Female—Head rounded ovate, the antennæ inserted distinctly below the middle of the face, much below the ventral ends of the eyes, eight-jointed-scape, pedicel, two ring-joints, three funicle joints and a solid club; scape somewhat swollen, the three funicle

joints subquadrate and subequal, each about half the size of the pedicel, the club long-ovate, about equal to the scape, slightly longer than the funicle. Parapsidal furrows distinct, complete; scutellum with a narrow longitudinal groove on each side of the meson; abdomen equal to the length of the head and thorax combined, ovate, depressed, the ovipositor barely projecting beyond its tip. Wings ample, normally ciliate, the marginal fringes short, the marginal vein long, a fourth longer than the submarginal, the postmarginal a mere spur-like projection beyond the origin of the stigmal which is distinct, with a neck and uncus. Tarsi four-jointed, the tibial spurs single. Mandibles dentate.

Male—Not known.

Type—The following species.

1. *Selitrichodes fasciativentris* new species

Female—Length, 1.20 mm.

Lemon yellow, the abdomen dorsad with two transverse black stripes across it, both bands interrupted at the meson; a third stripe indicated proximad (across the base) by a black spot at the edge on each side; the two stripes are across the distal half of the proximal half of the abdomen. Legs, antennæ and venation (more pallid) concolorous, the wings hyaline. A more or less obscure dusky spot near the tegula. Eyes and ocelli red.

(From four specimens, the same magnification).

Male—Not known.

Described from four females remounted on a slide in xylol-balsam from a card, received from the Acting Government Entomologist of Victoria and labelled "Chalcids parasitic on unknown galls on Eucalyptus, N. S. W."

Habitat—Australia, New South Wales.

Types—The above females on a single slide. No. Hy 1198, Queensland Museum, Brisbane.

PEDIOBINI

Metacrias new genus

Type—The following species.

1. *Metacrias australiansis* new species

Female—Length, 2.10 mm. Very dark metallic bluish, the head tinged with metallic green, especially on the face, the abdomen brilliant metallic bluish-green, shining. Wings hyaline, the venation dusky. Knees, tips of tibiæ, distal third of posterior tibiæ and the tarsi (excepting distal joint) white. Venter of thorax steel blue. Antennæ concolorous with thorax but the ring-joint white. First funicle joint nearly as long as the club, the pedicel subequal in length to the distal funicle joint. The legs and propodeum may be as in the male. Segment VI of abdomen (dorsad) densely polygonally retriculated.

(From five specimens, the same magnifications).

Male—The same but the abdomen less pointed, with an oval, large whitish spot centrally, near base, the antennæ metallic greenish, the abdomen with more green, the propodeum and the dark parts of the legs brilliant metallic cyaneus; distal two funicle joints subequal, the first joint subequal to the club.

(From single specimen, similarly magnified.)

Described from one male and five female specimens, card-mounted, from the collections of the Queensland Museum, labelled "Bred out of fungus gall on wattle. Brisbane, H. Hacker, 14/7/11", 1♂, 2♀'s and the same plus "23/6/11", 3♀'s.

Habitat—Australia—Brisbane, Queensland.

Types—No. Hy 1199, Queensland Museum, Brisbane, the above specimens on two cards as indicated plus two slides of xylol-balsam, bearing female antenna and posterior legs (one slide) and male flagellum.

This genus differs from *Acrias* Walker in bearing nonfasciate wings and submoniliform antennæ, the funicle joints more or less excised or constricted, and the club with one less joint. The following generic characters: Head large, wider than the thorax, the occipital margin carinate, the lateral ocelli not touch-

ing the eye margin, the vertex sloping cephalo-ventrad, the antennæ inserted distinctly below the middle of the face yet still slightly above an imaginary line drawn between the ventral ends of the eyes, the bulbs rather widely separated, the scrobicular cavity rather shallow, oblong, not reaching by some distance to the cephalic ocellus. Scape long, cylindrical and slender, much longer than the club; an obconic pedicel, one ring-joint, three funicle joints, the second bevelled off at apex, the third oval and subpetiolate at apex, a two-jointed, short, conic-ovate club, its smaller distal joint terminating in a nipple-like spur; its proximal joint forming more than half of the whole region. Club only slightly wider than the funicle. Posterior tibiæ armed with a single long acuminate spur; tarsi four-jointed. Marginal vein long and slender, only slightly shorter than the submarginal, the postmarginal and stigmal veins very short, the latter longer but with only a very short neck. Marginal fringes very short. Abdomen with a very short petiole, usually not visible, conic-ovate, depressed, the second segment a fourth of its length, the third a half shorter, the fourth transverse, the fifth only slightly shorter than the third, lightly reticulated cephalad, the sixth longer than the third, densely reticulated, hairy. Abdomen widest at apex of the second segment. Head and thorax opaque, rather densely reticulately punctate but the propodeum shining, brilliant and delicately reticulated, with a distinct, acute median carina, crossed by another short one at apex, the carina banded on each side by a deep longitudinal sulcus, whose lateral margins are carinæ and caudad join the ends of the short transverse carina; also the median carina at immediate base divides. Scutellum without longitudinal grooves, the parapsidal furrows obsolete, the mesothorax bearing very long, black, isolated setæ. Propodeal spiracle round.

The male is the same but the abdomen is distinctly petiolate, oval, less pointed and angular, the genitalia exserted; also the antennal club is longer and more slender, the funicle joints all subpetiolate, the pubescence longer and softer; the first funicle joint is longer, as long as the more slender club. Segments

III, IV and V of abdomen transverse. Antennæ the same except as noted.

This genus should be compared with *Eriglyptus* Crawford.

TETRASTICHINI

Genus *Tetrastichus* Haliday

1. *Tetrastichus victoriensis* new species

Female—Length, 1.35 mm. Shining black, the median grooved line of the scutum and the lateral margins of the scutellum straw yellow as are also the antennæ and venation, tarsi, knees and portions of the tibiæ; thorax with metallic purplish reflections. Wings very slightly embrowned throughout. Thorax extraordinarily finely longitudinally lined. A slight stain under apex of stigmal vein. Antennæ normal (ten-jointed, two ring-joints), the pedicel long obconic, the proximal and distal joints of the funicle subequal, joint II shorter than either and subquadrate.

(From six specimens, the same magnification).

Male—Not known.

Described from six female specimens mounted on a single card labelled "Chalcids parasitic on cynipid galls on *Acacia discolor*, Melbourne". Received from the Acting Government Entomologist of Victoria, C. French Jnr.

Habitat—Australia—Melbourne, Victoria.

Type—No. Hy 1200, Queensland Museum, Brisbane, the above specimens, plus a slide bearing a fore wing and head.

2. *Tetrastichus fasciatus* new species

Female—Length, 2 mm., more or less. General color lemon yellow, the abdomen darker; disk of the cephalic half of the scutum darker like the abdomen (except more or less along the meson), the center of the scutum with a fuscous round spot on each side of the meson, each spot at the apex of the darker portions on each side; propodeum cephalad, parapsidal furrows and suture between scutum and scutellum, black; also the margins of the scutellum more broadly laterad. Abdomen more or less distinctly banded transversely with black (very

distinctly so in balsam-mounted specimens, there being from six to seven bands). Legs, venation and antennæ yellow, the latter more or less dusky, the tarsi fuscous. Wings hyaline. Propodeum dark. Scutellum with four longitudinal grooved lines. Body finely, polygonally reticulated, the abdomen somewhat more coarsely so. Normal for the genus but the antenna apparently with three ring-joints, though in most cases but two are visible. Antennæ clavate, the funicle widening distad.

(From nine specimens, the same magnification).

Male—not known.

Described from nine females mounted together on a card in the Queensland Museum, labeled "Bred from gall No. 13".

Habitat—Australia—Queensland (?Brisbane).

Types—No. Hy 1201, Queensland Museum, Brisbane, six of the above specimens plus a slide bearing two others.

OMPHALINI

Rhicnopeltella new genus

Female—Head normal, not thin as seen from above, the antennæ capitate, the club three-jointed, simple and ovate, much wider than the funicle, the latter three-jointed, short, clavate, the joints all wider than long and widening distad, the first transverse, the funicle shorter than the club; three subequal ring-joints, each of which is about half the length of the transverse proximal funicle joint. Scape cylindrical, moderate in length, the pedicel short, obconic but longer than any of the funicle joints, the club joints much longer than it. Marginal vein not half the length of the submarginal, nearly twice the length of the stigmal which is well-developed but not large, the postmarginal vein very short, not half the length of the stigmal. Marginal fringes short, the discal ciliation normal. Parapsidal furrows complete, the scutellum without longitudinal grooves, the tarsi four-jointed, the posterior tibiæ with one spur which is moderately long. Abdomen from dorsal aspect rounded oval, wider than the rest of the body, depressed and not as long as the thorax, the ovipositor not exserted. Propodeum very short,

especially at the meson, without noticeable carinæ, the spiracle small, oval. Metallic, sculptured, the pronotum short, the ocelli widely separated but close to the eye margins, the distal joint of cephalic tarsus enlarged, swollen. The antennæ inserted slightly below the middle of the face. Wings hyaline; second abdominal segment a third the length of the abdomen.

Male—(See beyond).

Type—The following species (*immaculatipennis*).

1. *Rhicnopeltella immaculatipennis* new species

Female—Length, 1.75 mm. Short and rather stout. Dark metallic ænous green, the antennal club, the funicle (less so), the venation, the tarsi excepting the apex of the distal joint (the entire joint in caudal legs), the knees and tips of tibiæ (most all of cephalic tibiæ) brown, the venation and funicle darkest. Tegulæ concolorous. Whole body densely polygonally reticulated, the abdomen and propodeum, however, smoother. Lateral ocelli much farther from each other than each from the cephalic ocellus, than they are from the respective eye margins (farther from each other than each is from the cephalic ocellus). Distal club joint shortest of the club, the distal funicle joint longer than it. Stigmal vein shaped like a tadpole.

(From a single specimen, similarly magnified.)

Male—Unknown.

Described from a single female specimen from the collections of the Queensland Museum, mounted on a card labeled "Brisbane. H. Hacker. 4/7/11".

Habitat—Australia—Brisbane, Queensland.

Type—No. Hy 1202, Queensland Museum, Brisbane, the forenoted specimen.

This genus is characterized by the peculiar antennæ—the three ring-joints, the enlarged club, the short clavate funicle, the simple cylindrical scape. A somewhat similar genus was thought to be represented by the following species which, however, proves to be congeneric.

I give its generic characters first and then the specific details.

Male—Somewhat like the female of the genus but differing

structurally as follows: The antennæ bear only two ring-joints, there being four transverse funicle joints and three club joints, the pedicel long and slenderly obconic; the postmarginal vein is two-thirds as long as the stigmal and the fore wings bear a substigmal, fuscous cloud. The body is brilliantly metallic. The marginal vein is longer, nearly half the length of the submarginal. Scutellum without grooved lines. Posterior tibiæ with a single long spur. Abdomen depressed, oval. Propodeal spiracle central, small, round-oval, the propodeum without a median carina nor spiracular sulci. Vertex large. Otherwise as in the type of the genus.

Female—The same but the abdomen is stout, short, compressed beneath, the ovipositor slightly exserted. The antenna has three rings and three funicle joints and the club is more compact.

2. *Rhicnopeltella splendoriferella* new species

Female—Length, 2 mm. Brilliant metallic green, the abdomen dark cupreous, the legs concolorous with the abdomen and with their articulations whitish; coxæ metallic bluish; tibiæ lighter, the proximal half or more of the caudal tibiæ white. Flagellum brownish. Wings hyaline but the fore wings with a lightly fuscated rounded area under the apex of the stigmal vein and beneath most of the marginal vein; venation dusky brownish. Head and thorax rather finely, densely reticulated, the reticulation not coarse enough to form punctures but the sculpture of fine polygonal striation, on the abdomen and propodeum smoother.

(From a single specimen, similarly magnified).

Male—Length, 1.75 mm. The same but much more brassy and bronzy, the vertex metallic rosaceous, the same color on much of the thorax and head, the abdomen brighter green; legs with more brownish. Scape and pedicel brown, the flagellum dark brown.

(From twelve specimens, the same magnification).

Described at first from twelve males and one female mounted together on a card in the Queensland Museum, labeled "Bred from gall No. 5A. Brisbane, H. Hacker. 20/6/11".

Habitat—Australia—Brisbane, Queensland.

Types—No. Hy 1203, Queensland Museum, Brisbane, the foregoing specimens as noted, together with a slide bearing male antennæ, posterior legs and a fore wing in xylol-balsam (one slide); and a second slide bearing a female antenna.

Later, another card was found in the same collection bearing six females labeled "Brisbane, H. Hacker, 11/1/1911". This second species differs from *immaculatipennis* (females) in bearing a much longer antenna pedicel, a longer marginal vein, a fuscous cloud on the fore wing, a stouter abdomen and brighter green color.

A Species of Collembola Found With Termites

GERTRUDE BACON

In a grove of live oaks near Claremont, there are great masses of dead leaves under the trees. Under this mantle of dry foliage there is often a considerable amount of decomposed material which may retain some moisture for a time. In this location there are many Collembola of various sorts. In places, twigs from the trees are mingled with the damp remains and these are very often inhabited by termites or white ants. These insects live in the tunnels which they make in every direction in the wood. In these spaces and perhaps also in some smaller crannies a small white insect was found quite constantly. At first it was supposed that these were blind Collembola without the furcula, but when touched they jumped very quickly. It was also found that they had eyes.

These forms were found to correspond exactly to *Entomobrya binoculata,* described by Harald Schoett in his article on North American Apterygogenea, in the Proceedings of the California Academy of Sciences, volume VI, 1896.

Length—1.5 mm. *Color*—Opaque white. *Body*—Subcylindrical, very hairy. On the head and neck the hairs are long and clubbed. *Eyes*—One on each side of the head. These are located in irregular masses of light brown pigment in some specimens. There seems to be some indication of a bilobed condition of the eye spots. *Antennae*—Not as long as the body but longer than the head. The segments are: I shortest, II and III subequal, IV nearly twice as long as III. *Claws*—Two. Superior claw has three teeth on the inner margin, the two upper of which are opposite each other. The inferior is lanceolate and unarmed. *Furcula*—This does not quite reach the ventral tube. Dentes slightly longer than the manubrium. *Mucrones*—With two strong teeth and a slender basal one which points distally and almost reaches the middle tooth. This species was found at Berkeley, California, but nothing is mentioned by Schoett as to the distribution.

It is possible that this species may occur in other locations than in the dwelling places of white ants, but so far we have found them in no other environment.

(Contribution from the Zoological Laboratory of Pomona College.)

Shorter Articles and Reviews of Recent Important Literature

INJURIOUS AND BENEFICIAL INSECTS OF CALIFORNIA

E. O. ESSIG

Month. Bul. State Com. Hort. Vol. II, Nos. 1 and 2.

This is certainly one of the most useful bulletins for the farmer and for all others interested in insects and their control in California. It considers the different orders of insects which are found in the state and discusses them clearly. This is aided by an unusually large number of good cuts, many of them being the work of the author while in college and later. In the back of the bulletin the composition of the different insecticides is given, as well as the various methods for their application. Here are also found all the state horticultural and quarantine orders relating to insects. There is also a host index of injurious insects described or cited. Mr. Essig surely is to be congratulated for this good and useful work.

George Ash.

A GIANT COCCID FROM GUATEMALA

WILLIAM MORTON WHEELER

Psyche, Feb., 1913.

This was found on the branches of an *Erythrina* tree. From a distance the tree looked as if it were covered with galls the size of cherries. The specimens were 11-20 mm. in length, 10-15 mm. in width, and 9-14 mm. in height. The body was smooth, and elliptical in shape. They were pale brownish yellow in color and covered with minute dots. They were only found on this one tree.

Gertrude Bacon.

THE SOMBRE TWIG-PRUNER, *THERCLADODES KRAUSSI*, WHITE

CLAUDE FULLER

The Agricultural Journal of the Union of South Africa, Feb., 1913.

This beetle attacks privet, jassamine, and olives, but has not become much of a pest, as it can be rather easily controlled by pruning. If olive growing were extensive, however, it would probably cause trouble.

The life of the larva is interesting. The egg is laid in a little cavity excavated about six inches from the end of the stem. As soon as the larva hatches, it bores up about one inch, then enlarges the cavity, turns around, and works down to between one and two inches below the site of the egg. It then backs up to the enlargement, turns around, and backs down to the bottom, where it remains for some days, then ascends for a little distance and girdles the twig, which breaks off. It then plugs up the hole and descends to the bottom of the burrow to moult. After moulting, the whole process is repeated, and it is repeated with each moult until the larva pupates.

Mabel Guernsey.

ABSORPTION UND SECRETION IM DARM VON INSECTEN

ALBRECHT STEUDEL

Zool. Jhrb. Bd. XXXIII, Heft 2, 1913

The most important conclusion is that there is a double function for the intestinal epithelial cells which are active, the function of absorption and secretion. Many authors describe a rest and a secretion stage. In Periplaneta and other insects absorption takes place during the rest stage. In many if not all insects the intestinal epithelium has this double function.

EINFLUSS DER AUSSEREN UMGEBUNG AUF DIE FARBUNG DER SCHMETTERLINGSPUPPEN (*VANESSA UTRICAE*)

HEDWIG MENZEL

Zool. Jhrb. Bd. XXXIII, Heft 2, 1913.

Boxes were prepared in different ways so as to give a single color of light to the interior of each. Larvæ were kept in these boxes for some time. The data in the tables compiled from these experiments show that the variation in color in the pupa stage is caused by the influence of the different colors on the larvæ. These colors correspond to those found in nature, but the rate of variation in the boxes is different according to the color of the light which enters.

Larvæ reared in a certain color showed a decided preference for this when given their choice of this color and another one. This power of discrimination results much more because of a certain feeling for brightness rather than upon a qualitative chromatic selection.

THE EURYPTERIDA OF NEW YORK

CLARK AND RUEDEMAN

Published by the New York State Department of Education, 1912

Of all regions of the world, the Siluric rocks are the richest in eurypterids. The majority of the specimens come from a narrow belt of territory along the Erie canal from Buffalo to Albany. Many of the fossils were secured from fences and old stone buildings where weathering had exposed them. It was found very difficult to get them from freshly quarried rocks, as even five years of exposure had little effect.

The first eurypterid fossils to be found were supposed to be from some sort of fish. Their arthropod nature was determined by De Kay in 1825. He considered them to be crustaceans of the order Branchiopoda and suggested that Eurypterus might be a connecting link between the ancient trilobites

and the more recent branchiopods. The body of the eurypterid is rather fish-like in shape and has a carapace or head-shield. It is generally believed that it was fitted either for crawling, digging or swimming. It is supposed that it was rather sluggish.

The work is published in two large volumes. The first part contains an account of the characteristics, development and habits of the creatures, as well as a description of the different genera and species. The second volume is made up of many fine plates and figures.

Elizabeth Jacks.

DIE CORPORA ALLATA DER INSEKTEN

ARTHUR NABERT

Zeit f. Wiss. Zool. CIV Bd., 2 Heft, 1913.

These organs are glands with an internal secretion found in all groups of insects and may be paired or unpaired. In shape they are like a bullet or oval in outline, but may develop a hilum on one side. They are generally closely associated with the pharyngeal ganglia which lie along the esophagus. Usually they bear a certain relation to the aorta, to a tracheal vessel and the esophagus. They are inervated by the nervus corpis allati from the side of each of the pharyngeal ganglia.

BOOK REVIEWS

PRINCIPLES OF ECONOMIC ZOOLOGY. L. S. and M. C. Daugherty. 410 pages, with 301 illustrations. W. B. Saunders Company, 1912. Text $2.00; Guide $1.25. Cloth.

This is intended as a text-book of zoology, with especial reference to the economic side of the subject. The various phyla are taken up in order and a general description of each is given, as well as descriptions of the chief subdivisions, with brief discussions of the habits and economic importance. There are many examples given, with descriptions and discussions,

and here the economic side of the question is brought out more fully. The book contains 410 pages and is profusely illustrated, although but few of the cuts are original.

The text-book is accompanied by a laboratory manual of 276 pages which gives directions chiefly by means of numerous brief questions which the student is to answer by means of direct observation. Directions are given for general studies in ecology, animal behavior and classification, as well as detailed studies of the crayfish, spider, insects, fish, frog, turtle, bird, rabbit, man, Protozoa, Porifera, Coelenterata, Echinodermata, Annulata, and Mollusca.

Mabel Guernsey.

THE EARLY NATURALISTS: THEIR LIVES AND WORK (1530-1789)

L. C. MIALL, D. SC., F. R. S.

MacMillan and Co., Ltd., 1912. 396 pages. $3.50.

David Starr Jordan in one of his inspiring essays, called "Life's Enthusiasms," says: "It is well that we should know them, should know them all, should know them well—an education is incomplete that is not built about a Pantheon, dedicated to the worship of great men." The preface to this book of Miall expresses the same idea; every naturalist and student should become acquainted in as large a way as possible with the naturalists of the past—their contributions to science, their methods of work, as well as their mistakes and failures and idiosyncracies. This is a fascinatingly interesting book, and ought to be read by every student of the natural sciences, especially those in our colleges and universities. The only fault to be found with the book is the lack of portraits; but the full sketches of the lives of the men helps to counterbalance this omission; we have such sketches from Otto Brunfels to Linnæus and Buffon. Most of the long line of naturalists here dealt with were occupied wholly or in part with insects. Malpighi was the first to observe the air-tubes and spiracles, the many-chambered heart, silk glands, gangliated nerve cord, re-

productive organs, development of the wings and legs of the moths, and the Malpighian tubules which were named after him. Now read about the interesting personality of the man! Reaumur was perhaps the greatest entomologist, and as an observer cannot be excelled, even today, except possibly Fabre, for his observations on the habits of insects, as described in the six volumes, Memoires pour Servir a l'histoire des Insectes, 1734-1742. Reaumur was largely occupied in the industrial arts and general physics and other lines. He invented the thermometer which bears his name.

Of greatest value, the lives of these men teach what two of our great Californian scientists—Dr. George E. Hale and Dr. Wm. E. Ritter—call and urge, the amateur spirit in science. Dr. Ritter defines it thus: "A spontaneous, perennial curiosity; a wide-awakeness of perception; an openness of mind; and a nimbleness of imagination, as touching all sorts of objects and processes and incidents in one's surroundings." This, as he goes on to show, does not necessarily beget superficiality, as many present day biologists believe, but is a very useful quality to cultivate and overthrow the current professionalism in science which is apparent especially in academic circles. The same idea is expressed in Dr. Jordan's essay already quoted from: "And my message in its fashion shall be an appeal to enthusiasm in things of life, a call to do things because we love them, to love things because we do them, to keep the eyes open, the heart warm and the pulses swift as we move across the field of life." *F. Grinnell, Jr.*

A SYNOPSIS OF THE RECENT AND TERTIARY FRESH-WATER MOLLUSCA OF THE CALIFORNIA PROVINCE, BASED UPON AN ONTOGENETIC CLASSIFICATION

HAROLD HANNIBAL

Proceedings of the Malacological Society of London, Vol. X, Pts. II and III, June and Sept., 1912; pp. 112-211, plts. V-VII.

The author of this paper, a young and very enthusiastic Stanford student, has covered a good portion of the Pacific

Coast from San Diego to Seattle, with his bicycle, in search of shells; investigating every puddle, pool, pond, lake, ditch, stream and river in his trips. He has collected material in large quantities and then studied it in the laboratory; so from training and experience he is more capable of writing on the fresh water shells of this coast than anyone. This, the most extensive of his published papers, is full of original ideas, and numerous suggestions. He first gives the boundaries of the California province in detail, then the composition of the fauna as found in the paleontological history of the region; thirdly, the classification employed; fourthly, the new term *Syntonia* is explained in detail; then lastly, taking up most of the paper, the synopsis of species, in which the groups from the superfamily to species are defined. There is a full bibliography and synonymy for the genera and species; a table showing the Evolutionary Cycle of the Unionoideæ, and a summary and range in time of the Californian fauna, and concluding remarks.

Of course, a student with such radical ideas, a progressive, could not escape the fire of one or more of the conservative men; and this is just what happened in a recent number of The Nautilus. If you wish to smile, just look it up!

F. Grinnell, Jr.

News Notes

FORDYCE GRINNELL, JR.

"We shall certainly not discover Nature's plan in the structure of flowers by taking the plant out of the garden or country. We must rather study flowers in their natural habitats—in short, *we must try to surprise Nature in the act*."

—Sprengel.

"Nature never hurries; atom by atom, little by little, she achieves her work." —Emerson.

Mr. W. M. Mann, of the Bussey Institution of Harvard University, left on April 20 to spend the months of May and June collecting in Southern Mexico. On his recent trip to Haiti he collected two species of *Peripatus*.

The first Pacific Coast chapter of the Agassiz Association has been formed in Los Angeles, and choosing Burbank chapter for the name. Alfred Cookman is president.

Dr. Charles Lincoln Edwards, of the Los Angeles city schools, is conducting a fly exterminating campaign in Los Angeles county, this spring.

The Pacific Coast Entomological Society held a special meeting at Berkeley on April 10, in connection with the meetings of the Pacific Coast Association of Scientific Societies meeting in the same place.

Mr. G. R. Pilate is planning a collecting trip to the Kern River country of the Sierras, this summer, in the interests of Dr. Wm. Barnes. He is collecting this spring around San Bernardino.

Mr. L. E. Ricksecker, a pioneer student of Entomology, died at his home in San Diego on January 30. He discovered many new insects; first finding the curious habits of Pleocoma.

Mr. H. C. Fall, of Pasadena, is revising the large and difficult Coleopterous genus Pachybrachys.

Ralph V. Chamberlin, of the Museum of Comparative Zoology of Harvard University, paid a short visit to Southern California the past spring, with hopes of returning in the not distant future for a longer stay.

John James Rivers, of Santa Monica, the last surviving pioneer naturalist of California, is still active, and working on the pleistocene shells of Santa Monica. He is in his eighty-eighth year.

We learn from Science, of April 11, that Prof. M. M. Metcalf, head of the department of zoology at Oberlin, has been granted leave of absence for this past semester for travel and scientific research in California.

The contract has been let for the erection of the magnificent Southwest Museum buildings in Los Angeles, to cost about $100,000. Dr. Hector Alliot is curator.

At a general meeting of the Southern California Academy of Sciences in Los Angeles, on April 7, Dr. D. T. MacDougal, of the Desert Botanical Laboratory, gave an illustrated talk on "Some Physical and Biological Features of Deserts"; and at a meeting of the biological section on the 15th, Dr. C. L. Edward gave an account of some European biological stations.

Mr. Harry S. Swarth, formerly of the Museum of Vertebrate Zoology at Berkeley, has been appointed assistant director of the county museum in Exposition Park, Los Angeles.

A new entomological journal is announced from London, England, "The Review of Applied Entomology, Series A, Agricultural; Series B, Medical and Veterinary." The first has already been issued. "It is intended to contain, month by month, abstracts of the latest information published concerning insects injurious to man or animals, as the carriers of disease; and to forests, fruit trees, crops and stored merchandise." It is published by Dulau & Co., Ltd., 37 Soho Square.

"To the making of books there is no end."

Some New and Curious Acarina From Oregon

H. E. EWING

Up to the present time few indeed of the many species of Acarina known to science have been recorded from Oregon, and for that matter only a very few from California where the arthropod fauna has been well studied. A little over a year ago the writer began a survey of the mite fauna of the Pacific Slope, and in this article he has to report a few new species which are of unusual interest either because of their great size, or the significant or peculiar characters which they show. In the following pages six new species are described. Three of these are made the types of new genera; one of the species, *Michaelia pallida* n. sp., belongs to a family (*Alychidæ*), which has hitherto been unknown in this country.

Family BDELLIDÆ

Genus *Bdella* Latreille

Bdella magna n. sp.

(Fig. 1)

A large robust species; red throughout, but body darker than appendages. Integument not tessellated. Palpi large, total length over one and a half times that of the beak; second segment more than two-thirds as long as the beak; third segment slightly over one-half as long as the fourth; fourth segment about one-half as long as distal segment; distal segment of practically equal width throughout, about one and a half times as long as segments three and four combined, and bearing about a dozen prominent, straight, simple bristles besides the distal tactile ones. Inner tactile bristle of palpus about three-fourths as long as the outer one; outer tactile bristle about two-thirds as long as the distal segment. Beak stout, with several prominent curved, simple bristles, including a large pair situated dorsally slightly in front of the middle. Shoulder bristles rather moderate, about as long as the tibia

of leg II. Abdomen with a few short, simple bristles. Legs large, stout; leg I about as long as the body without the beak, tarsus twice as long as tibia and clothed with many prominent

Figure 1. *Bdella magna* n. sp.; dorsal view of cephalo-thorax with mouth-parts.

hairs; leg IV extending beyond the tip of the abdomen by the full length of the last three segments. Total length of body including the beak, 1.86 mm.; width, 0.65 mm.

From Corvallis, Oregon; under old pieces of wood lying on moist ground; by the writer.

Described from three specimens. This species is distinguished from all other American species by its great size, and from most of the other species of the genus by the length of the fourth palpal segment.

Family ALYCHIDÆ

Genus *Michaelia* Berlese

Michaelia pallida n. sp.

(Fig. 2)

Like the other members of its genus this species is pale or white in color. Integument alveolate; thickly clothed with minute scales, or spine-like tubercles. Stylets of cheliceræ needle-like, as long as the palpi, and bent near their base so as to form a sharp angle. Palpi slightly longer than the femur of leg I; distal segment slightly longer than the penultimate one, clothed with a few moderate trifurcate setæ, and bearing at its distal end a simple, straight, stout spine, which is about two-thirds as long as the segment from which it arises. Cephalo-thorax not demarcated from abdomen. Dorsal ridge prominent, and bearing at its anterior end the large median eye, and somewhat behind the middle a pair of long tactile setæ, each of which arises from a funnel-shaped pore. These setæ are slender, simple, and are equal to the dorsal ridge itself in length. From each side of the dorsal ridge at its posterior end there arises a specialized seta, or organ, similar to the pseudostigmatic organ in the Oribatidæ. Each of these organs consists of a slender stalk, or pedicel, and a subglobose head. The length of the pedicel is just equal to the long diameter of the head. Abdomen, which is not demarcated from cephalo-thorax, is about two-thirds as broad as long, and is incised on the posterior margin at the median line. It is very sparsely clothed with some small setæ, some of which are simple, some are bifurcate, and a few trifurcate. Legs subequal; anterior pair extending beyond the tips of the palpi by about one-half

their length; tarsus twice as long as tibia; tibia and genual subequal; femur almost twice as long as the genual. Posterior pair of legs extending beyond the posterior margin of the abdomen by

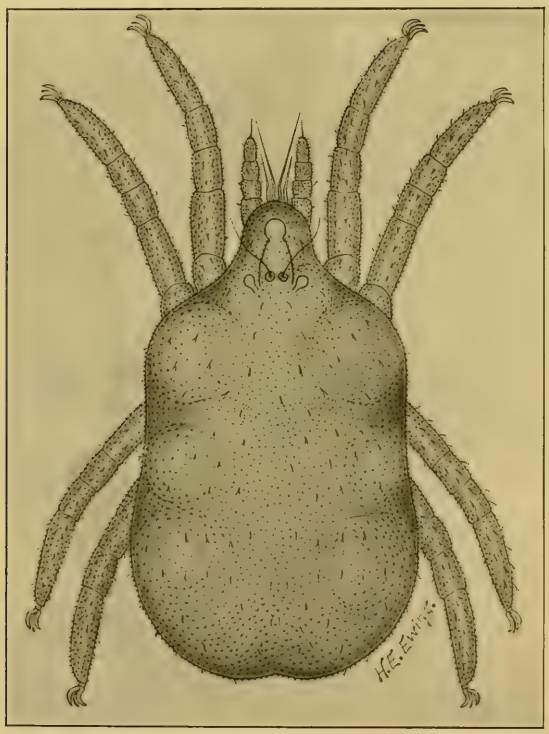

Figure 2. *Michaelia pallida* n. sp.; dorsal view.

about one-third their length. All the legs are sparsely clothed, like the body, with small setæ, some of which are simple, some bifurcate, some trifurcate, and some many-branched. All of

the legs bear at the tips of their tarsi two stout claws and a small pulvillus. Pulvillus a little over one-half as long as the claws and pectinated on its lower margin. Total length of body, 0.70 mm.; width, 0.42 mm.

From Corvallis, Oregon; in moss; by the writer.

Described from three individuals. This species appears to be related to *M. subnuda* Berlese. It differs from Berlese's species in having the body clothed with a different kind of setæ, in having more slender legs, and in having a large median eye, as well as in some other characters. This is the first species of this genus and the first representative of the family *Alychidæ* to be described from this country.

Family CÆCULIDÆ

Genus *Ceratoacarus* n. gen.

Palpi simple, tactile, non-raptorial, composed of four segments; first segment very short; second, long; third, long; fourth, short and bearing several long tactile bristles. Cheliceræ very large, almost enormous, chelate, moving vertically. Eyes three; two of which are lateral and sessile, one is anterior and median. Posterior part of cephalo-thorax and all of the abdomen covered above with a single, thick, coriaceous shield, which shield bears the posterior eyes. Anterior part of cephalothorax covered with a similar, thick, coriaceous shield which is separated from the former mentioned one by an incomplete suture, and bears a pair of large horn-like tubercles on its anterior margin. All four pairs of coxæ joined together, the coxæ of each pair meeting at the median line. No sternum. Ventral surface of abdomen covered by a single, thick, coriaceous plate which in the case of the female has a large aperture for the genital and anal openings. Each of the latter is closed by a pair of folding chitinous doors, or covers. In the male the genital and anal openings are separate, but are closed by chitinous folding covers as in the female.

Type species: *C. pacificus* n. sp.

This genus differs from *Cæculus* Duf. in that the palpi are not raptorial but tactile, are composed of four instead of five segments, and are unarmed instead of bearing claws. The eyes are sessile, not stalked as in *Cæculus,* and a single, median eye is also present. The arrangement of the shields which cover the body is different from that found in *Cæculus.* There is a pair of horn-like processes on the anterior part of the cephalo-thorax and another pair on the dorsal aspect of the cheliceræ. The legs are less spinous than in *Cæculus.*

Ceratoacarus pacificus n. sp.
(Fig. 3)

Female—Robust; body and anterior pair of legs reddish brown; the rest of the appendages a yellowish brown. Integument of the body, cheliceræ and the anterior pair of legs well chitinized and coarsely granular; the integument of the remaining parts of the body not so well chitinized and more finely granular. Cheliceræ very large, surpassing the palpi; together they are almost as broad at their bases as the width of the cephalo-thorax at its anterior end. Each chelicera bears at its anterior end a small, curved, simple hair; and above near the middle a prominent horn-like tubercle, which bears in turn a long, simple, tactile seta which extends beyond the tips of the cheliceræ. Segment I of palpus as broad as long; segment II slightly over twice as long as broad; segment III subequal to segment II; segment IV short, papilla-like, and bearing four large, long tactile bristles and one much shorter bristle. Cephalo-thorax not distinct from abdomen. Anterior shield about three times as broad as long, and bearing at each anterior lateral corner a prominent seta-bearing horn; seta of horn simple, curved, about twice as long as the horn itself and arising from the lateral side of the same about one-half the distance from the base. Median eye prominent, larger than either of lateral eyes. Posterior dorsal shield covers all of the abdomen and more than one-half of the cephalo-thorax; broadened at the shoulder region where are situated the lateral eyes, and just back of these a larger pair of sensory organs which

may serve as eyes, although they are quite different in form and structure from the true eyes. The posterior dorsal shield bears several prominent, curved, simple bristles, and a pair of

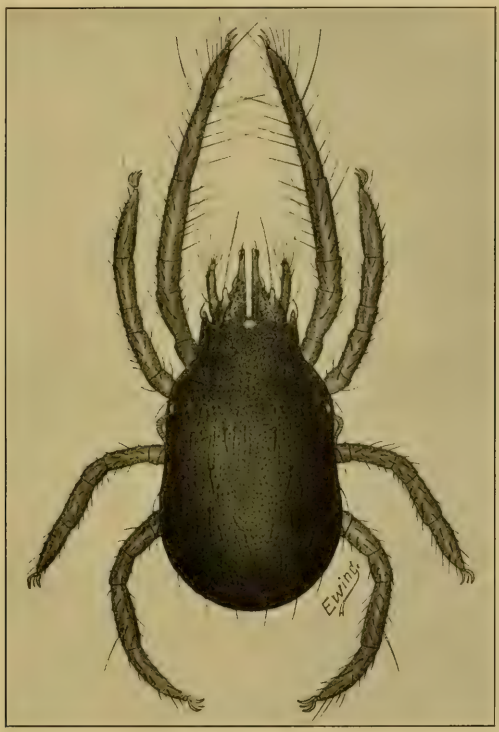

Figure 3. *Ceratoacarus pacificus* n. sp.; dorsal view.

small sensory bristles above and in front of the eyes. Genito-anal opening almost circular, as broad as long. Genital covers quadrangular, three-fifths as broad as long. Anal covers small

but little over one-half as broad as the genital covers, longer than broad, and projecting somewhat like a tubercle. Coxæ flat, fixed, joined to each other; coxa I almost as broad as long; coxa II narrower than I; coxa III narrower than II; coxa IV slightly broader than III. Anterior pair of legs much the largest, as long as the body; tarsus short, tapering, one-half as long as tibia. Second pair of legs much shorter than the first pair, only reaching slightly beyond the genual of leg I. Third pair of legs subequal to second pair. Fourth pair of legs longer than the third pair and extending beyond the tip of the body by about one-half the length of the tibia. Total length of body, 1.56 mm.; width, 0.80 mm.

Male—Similar to the female except for the characters on the ventral surface of the abdomen. Genital opening circular, much larger than the anal opening, and situated about one-half its diameter from the posterior coxæ; genital covers semidisc-shaped. Anal opening oblong, about twice as long as broad, and situated about one-third its length from the genital opening; anal covers about one-fourth as broad and long.

From the top of Mt. Chintimini, Oregon; under moist stones, and under rotten logs; by the writer. From Corvallis, Oregon; under an old piece of wood lying on moist ground; by the writer.

Described from four females and three males.

Family ORIBATIDÆ

Genus *Jugatala* n. gen.

Mouth-parts well developed; cheliceræ typical of the family, strong, chelate; palpi composed of five segments; first segment very short, ring-like; second, large, about as long as the remaining segments taken together; third and fourth, short, subequal; distal segment narrow, long, with prominent setæ. Lamellæ small, attached to the dorsovertex for their entire length. Translamella present. Interlamellar hairs present. Abdomen somewhat depressed, broad. Pteromorphæ curved downward, truncated anteriorly, and united by a large lamellar,

shelf-like expansion so that the two wings are continuous. Genital and anal openings large and widely separated. Legs moderate; ungues tridactyle, dactyles subequal.

Type species: *J. tuberosa* n. sp.

This genus is distinct from all other forms except some of the species of the genus *Pelops* C. L. Koch in having the pteromorphæ united with a broad shelf-like expansion from the anterior margin of the abdomen. It differs from *Pelops* in having stout, chelate cheliceræ instead of long-drawn-out, minutely chelate cheliceræ; in having all of the abdominal hairs setiform instead of some of them being spatulate, as well as in other characters.

Jugatala tuberosa n. sp.

(Fig. 4)

Color medium brown; appendages paler than the body. Integument of moderate thickness, granular. Cephalo-thorax almost as broad as long. Lamellæ small, of equal width throughout their length, about one-half as long as the cephalo-thorax; lamellar hairs long, straight, pectinate, extending to the tip of the cephalo-thorax. Translamella almost as long as one of the lamellæ, usually about one-half as broad as one of the lamellæ; at times it is almost obsolete, being broken in the middle. Interlamellar hairs subequal and similar to lamellar hairs, but slightly curved, divergent, situated slightly inward and in front of pseudostigmata. Pseudostigma cup-shaped; pseudostigmatic organ short with a short pedicel and a globose head. Two pairs of tectopedia present, one pair for the first and one pair for the second pair of legs; first pair long, shovel-like; second pair short, projecting, somewhat saucer-like. Abdomen depressed, almost as broad as long. Pteromorphæ extending for about one-half the length of the abdomen, truncated anteriorly, and each bearing dorsally a single, short, curved seta not far from its anterior margin. The transverse shelf-like projection which unites the two pteromorphæ or wings, which I will call the *interalar* piece, is quite broad; its

breadth being equal to about three-fourths the length of the translamella. Around the posterior margin of the abdomen are situated three pairs of prominent tubercles, or tuberosities,

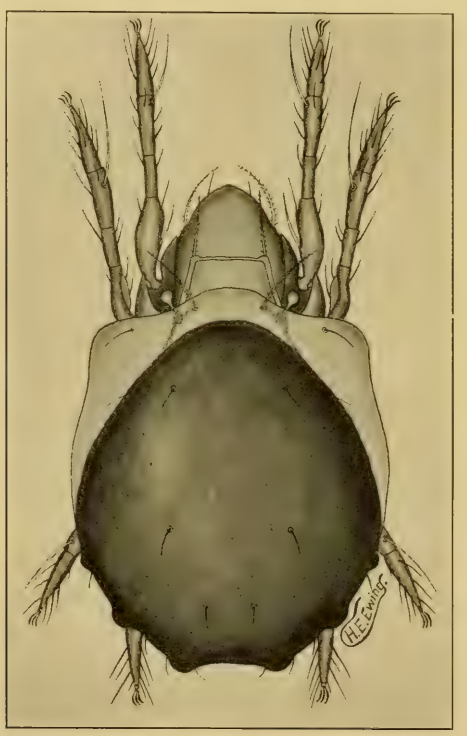

Figure 4. *Jugatala tuberosa* n. sp.; dorsal view.

the anterior pair being the smallest and the posterior pair the largest. On the dorsum of the abdomen are situated nine pairs of short, curved, simple setæ. Genital covers subrectangular,

two-thirds as broad as long, situated between the posterior pair of coxæ. Anal covers larger than the genital covers, about twice as broad posteriorly as anteriorly, and situated about one and a half times their length from the genital covers. Legs moderate; anterior pair reaching beyond the tip of the cephalothorax by fully one-half their length; posterior pair reaching slightly beyond the posterior margin of the abdomen. Ungues tridactyle, dactyles subequal. Total length of the body, 0.58 mm.; width 0.40 mm.

From Corvallis, Oregon; shaken from Douglas fir; by the writer.

Of the seven specimens which I have of this species six are females. This species is peculiar on account of the prominent tuberosities on the posterior part of the abdomen, hence its name, *tuberosa*.

Genus *Tenuiala* n. gen.

Mouth-parts rather small; cheliceræ, chelate; palpi composed of five segments; first very small; second very large, stout; third broad, short; fourth, short; fifth and last segment, long, with prominent setæ. Lamellæ attached to dorsovertex for their entire length. Translamella absent. Abdomen globose or subglobose. Pteromorphæ not hinged to abdomen; composed of a single large, long, cusp-like expansion which extends forward almost to the tip of the cephalo-thorax. Genital and anal openings widely separated. Legs moderate; ungues, tridactyle; dactyles subequal.

Type species: *T. nuda* n. sp.

This genus will doubtless include a few previously described species, but none of these appear to have the pteromorphæ with such a distinctive shape as this one. The long, narrow, anteriorly directed, macro-cusp-like ptermorphæ which are immovably attached to the abdomen constitute the most distinctive characteristic of this genus.

Tenuiala nuda n. sp.

(Fig. 5)

General color a very dark brown. Integument smooth and shiny. Cephalo-thorax small, about one-third as long as the

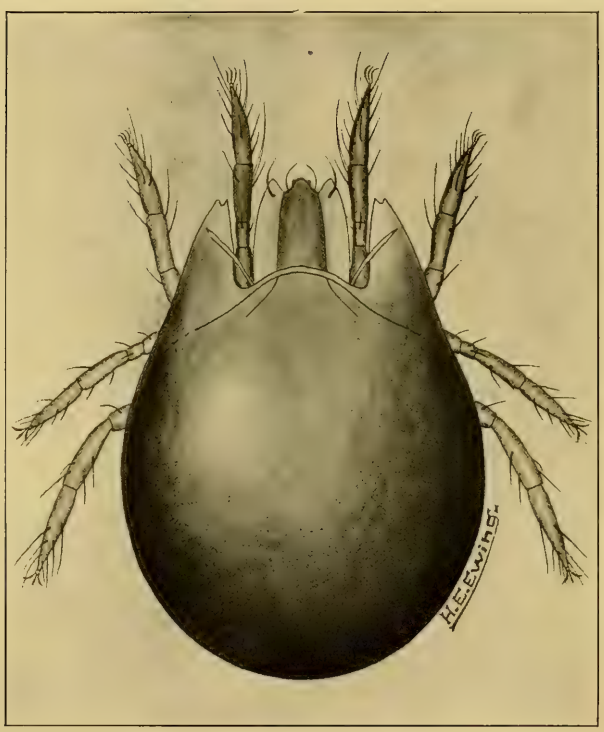

Figure 5. *Tenuiala nuda* n. sp.; dorsal view.

abdomen. Mouth-parts hidden from above. Lamellæ large. long, of equal width throughout their length, and extending

the whole length of the cephalo-thorax. Lamellar hairs short, curved, and situated on the anterior ends of the lamellæ about one-half the distance from the base of the same to their upper edges. Interlamellar hairs absent. Pseudostigmatic organs long, lance-shaped and slightly recurved. Abdomen globular, nude. Pteromorphæ rigid, extending forward almost to the tip of the cephalo-thorax, notched at their tips. Ventral plate as broad as long, shield-shape. Genital opening at the anterior margin of ventral plate; as broad as long, and situated about twice its length in front of the anal opening; genital covers triangular. Anal opening much larger than genital opening and situated about one-half its width from the posterior margin of ventral plate; anal covers rectangular; twice as long as broad. Legs moderate; posterior pair not reaching as far as the posterior margin of the abdomen. Total length of body, 0.86 mm.; width, 0.60 mm.

From the top of Mt. Chintimini, Oregon; under a rotting log; by the writer.

Described from four specimens. I can find no individual variations in any of them.

Family HOPLODERMIDÆ

Genus *Phthiracarus* Perty.

Phthiracarus maximus n. sp.

(Fig. 6)

A large dark brown species. Integument granular, of medium thickness. Cephalo-thorax about two-thirds as high as long, and bearing dorsally three pairs of large bristles. The posterior pair of bristles is about as long as the cephalo-thorax itself; the middle pair is slightly shorter; the anterior pair is slightly shorter than the middle pair. Pseudostigmata circular, shallow; in diameter about equal to the width of femur of one of the legs. Pseudostigmatic organ small, stoutly setiform. Abdomen about one-half as high as long, and bearing several prominent bristles, including five dorsal pairs. Posterior end of abdomen pointed. Genital covers about two-thirds as long as anal covers. Each of

the genital covers bears a row of small genital spines near its inner margin. Anal covers each bearing a few prominent setæ. Legs stout, almost equal; the anterior pair, however, is slightly the largest; tarsus of leg I one and a half times as long as tibia, tibia slightly longer than genual. Ungues stout, one-half as long as the tarsi from which they spring. Total length of the body, 2.00 mm.; height, 0.98 mm.

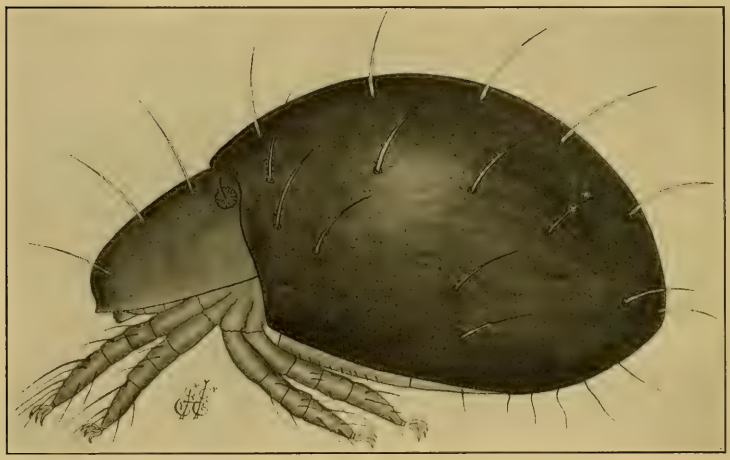

Figure 6. *Phthiracarus maximus* n. sp.; side view.

From Corvallis, Oregon; under an old piece of wood which was lying on damp ground; by the writer.

Described from three specimens. This species is at once separated from all others of the genus by its large size.

The Anatomy of *Laila Cockerelli*

MABEL GUERNSEY

In a recent number of this JOURNAL the circulatory system of this species was described. The present paper is a continuation of that anatomical study.

In cross-sections of the animal, the body-wall may be seen to consist of an outer layer of epithelium; within that a thick layer of rather spongy connective tissue, containing spicules, blood spaces, and in places gland cells; and within that again a thin layer of muscle lining the body cavity. The connective tissue and muscle stain with picro-fuchsin in a manner similar to mamalian muscle and connective tissue, the muscle fibres staining yellowish-brown and the connective tissue pink or reddish. The epithelium is very thin, consisting of a single layer of short columnar cells, containing a few mucus cells. Over the foot, however, it abruptly changes its character and the cells become much elongated and very strongly ciliated, except at the anterior margin of the foot, where they lose most of their cilia and assume the appearance of gland cells. The connective tissue layer is most dense over the back and becomes very loose and spongy in the foot, which contains a mass of blood sinuses. It contains numerous spicules in the back, a few at the sides, and a very few in the foot. These are irregular in shape and size, but usually large at the center and tapering toward the ends, with a small angle at the center. Sometimes there is a short branch springing off near the center or they are more sharply angled. Around the spicules, the connective tissue is condensed to form a capsule. In the foot the connective tissue contains masses of gland cells, grouped just below the epithelium. Over the main part of the foot these masses are rather scattered and small, but at the anterior angle they abruptly become very numerous and closely packed and the separate cells become larger. Here also, as has been said, the epithelium changes, losing most of its cilia and resembling the gland cells in staining reaction. The muscular layer consists partly of a distinct layer lining the body cavity and partly of strands of muscles extending

through the connective tissue. The lining of the body cavity is thinnest over the back (10 microns), thickest over the side (30-40 microns) and slightly thinner over the foot than over the sides, but here it is strengthened by additional fibres in the connective tissue. These form a layer just above the glandular part of the foot, as well as an interlacing network of fibres. Fibres also branch off from the lining layer at the sides, above and below, and run diagonally towards the mantle edge, towards the outer angle of the foot, and into the papillæ.

The papillæ are club-shaped processes, coming off from the mantle edge in groups of various sizes. They are covered with an epithelium similar to that covering the rest of the body and contain a large branch of the mantle nerve, a large blood sinus, a core of spicules, and a gland. The sinus extends along the dorsal side of the papilla. At first it has a distinct wall, but the upper portion breaks up into branches which communicate with interstices in the very spongy connective tissue of which the body of the papilla is composed. The nerve lies just ventral to the sinus. It gives off many branches in its course and finally terminates in the gland at the tip of the papilla. The core of spicules extends from the base of the papilla for about two-thirds of the distance to the tip, on the ventral side. It is surrounded by a layer of circular muscle fibres and receives the fibres spoken of above as coming off diagonally from the muscular layer of the body wall. The gland of the papilla is situated at the tip. It consists of a spherical mass of cells enclosed in a heavy wall, and opening by a short duct surrounded by a thick mass of circular muscle fibres. Nearly all of the cells of these glands were empty in the preparations, probably because the animal discharged the secretion when it was killed, but a few contained large, dark-staining granules in a lighter, alveolar mass. These full cells were pear-shaped, the nucleus being situated at the base at the smaller end, and the cells were apparently attached to the basement membrane by long, slender processes. As the whole structure of the gland would indicate that it is intended to forcibly eject the secretion, it seems likely that it is used as an instrument of defense.

The Alimentary Canal. The mouth opens on the ventral side, as a large, laminated opening covered with ciliated epithelium, which leads into a cavity in which the end of the buccal mass projects. This buccal mass consists of two layers of muscle with a food chamber between. The outer layer consists of a heavy mass of circularly disposed fibres, opening anteriorly into the mouth cavity by means of a narrow slit. This outer mass is covered by a regularly ridged cuticle, secreted by a layer of short, columnar cells, which is especially heavy near the free end and becomes thin and flat near the base of the buccal mass.

Within these circular muscles is a cavity into which projects the muscles over which the radula moves. These consist of two lateral masses, fastened together below by a band of muscle, and above by a thin layer which consists mainly of epithelium. Between these two masses is a cavity, which communicates directly with the arterial system. The radula is grooved above this cavity so as to dip down into it. Toward the posterior end of the buccal mass sinuses appear between the outer muscles and the epithelium lining the buccal cavity and extend in size, as the buccal food cavity diminishes, so that the posterior part of the muscles of the radula is almost entirely surrounded by sinuses. When this takes place the sinus between the radula muscles communicates with those surrounding them. At the posterior end of the buccal mass the different sets of muscles gradually blend together. The gland where the formation of the radula takes place is situated in the continuation of the groove between the muscles over which the radula moves. It is situated at the extreme end of the buccal mass where it projects as a little knob. It is lined with tall slender columnar cells, with a dark-staining granular protoplasm and oval nuclei situated near the center of the cell. At the upper side of the capsule is a mass of undifferentiated tissue from which several layers of large irregular shaped cells branch off. In the space between these two kinds of cells the radula is formed, the teeth probably by the irregular inner cells and the basement membrane by the columnar lining layer. From the mouth the food passes through the cavity between the two sets of muscles, and up over the

radula, as the cavity narrows. About half way between the two ends of the buccal mass the œsophagus branches off on the upper side, but the buccal food cavity does not end when this takes place, but extends as a blind pocket nearly to the end of the buccal mass.

Close to the point where the œsophagus branches off, minute ducts from the salivary glands enter the buccal food cavity, one on each side. These glands are long, unbranched tubes, lined with cubical epithelial cells. They lie loosely in the body cavity back of the buccal mass, and in two specimens examined the ends were fused.

After leaving the buccal mass the œsophagus goes back between the ganglia of the central nervous system, gradually becoming larger, passes below the liver, and enters the stomach on the under side. The stomach itself is rather small but communicates with the liver by numerous large openings, so as to make its actual capacity considerably larger. The stomach is lined, as are the œsophagus and intestine, with ciliated epithelium. The liver consists of branching tubes lined with tall columnar cells with a fine granular protoplasm. On the upper side of the stomach is a cæcum, about twice as large as the intestine, in diameter, which is lined with glandular cells of a different character than those of the liver. Directly in back of this cæcum the intestine leaves the stomach. It runs forward over the surface of the liver to the extreme anterior end, then curves to the right and runs back to a point just beneath the branchiæ, where it becomes slightly enlarged and laminated and curves upward to open within the circle of the branchial plumes.

The Nephridium. The kidney is a thin-walled sac with many ramifications that cover the whole surface of the liver mass and extend for a short distance down the sides. The walls are formed by a single layer of large, cubical granular cells on a very thin basement membrane. These contain round, dark-staining nuclei and a small amount of protoplasm near the base, the rest of the cell usually being clear. The kidney communicates with the pericardium near the point where the right lateral sinus enters the right auricle, by means of a tubular

valve lined with cubical cells, bearing remarkably long and heavy cilia. The external opening of the kidney is by a short slender canal that ends on the anal papilla, just in front of the anus.

The Nervous System. The nervous system of *Laila cockerelli* is centralized in a manner similar to that of the typical Doridida. In the cerebro-pleural mass the fusion seems even greater than usual, so that when viewed from above no distinction into cerebral and pleural ganglia can be made out, although on the under side two distinct lobes are visible. Below the posterior part of the cerebro-pleural are situated the pedal ganglia, which are well developed and joined to them by very short connectives. There are also a pair each of olfactory, optic, and visceral ganglia, making six pairs in all of supra-œsophageal, as well as the single pair of buccal ganglia, which are infra-œsophageal. The buccal ganglia are normally situated most anteriorly, but their position relative to the rest of the ganglia varies with the position of the buccal mass, as the buccal ganglia have a fixed position close to the origin of the œsophagus and so are moved forward and backward when the buccal mass is moved, while the other ganglia are comparatively stationary.

The buccal ganglia are ovoid, about 200 microns in the longest diameter, joined to each other by a very short commisure, and to the cerebral by a long, slender connective that has its origin a short distance in front of the cerebro-pedal connective. They give off four pairs of nerves. Three of these enter the buccal mass directly, the posterior pair going to the region of the origin of the tongue. The fourth pair, which bear numerous minute ganglia, go upwards to the œsophagus, and run backwards between it and the salivary glands, to which branches are probably given, and continue back to the liver mass, where they probably join the network of accessory nerves and ganglia, although this could not be positively determined in the specimens examined. This accessory system, which is described by Hancock and Embleton as covering the stomach and the lobes of the livermass in Doris, is very delicate in this

species, and all that could be seen in the sections were occasional very minute ganglia. The gastro-œsophageal ganglia which are described as occurring on the anterior border of the buccal ganglia in typical Dorididæ, are apparently completely fused with the buccal, which are regularly ovoid in shape and show no protuberances or other trace of the gastro-œsophageal ganglia, excepting the single nerve.

The olfactory ganglia, which are about 150 microns in their longest diameter, are closely attached to the upper, anterior border of the cerebral. They give off a single pair of large nerves, the olfactory. These go forwards for some distance and pass through the muscles of the body wall, but instead of entering the rhinophores directly, go downward and then bend sharply, thus making an S-shaped bend in their course. This is undoubtedly because of the retractility of the rhinophores, all of the observations being of necessity made on retracted rhinophores, as the animal withdraws them upon the slightest disturbance. Within the trunk of the rhinophore in the contracted condition, the nerve has a knotted and twisted appearance.

The cerebro-pleural ganglia are by far the largest, measuring nearly .5 mm. lengthwise. They are roughly rectangular in shape, and, as has been stated, appear from the upper side as a single pair of ganglia, but on the lower side are divided transversely into two lobes. In section also they show a transverse division into two centers. They are connected dorsally by a large, very short, cerebro-pleural commissure, which contains fibres anteriorly from the cerebral and posteriorly from the pleural portions of the ganglia. Ventrally they are joined by the visceral commissure, which bears the visceral ganglia and has its origin on the under side of the posterior part of the pleural ganglia. Besides the nerves of the rhinophores, eyes, and otocysts, the cerebro-pleural ganglia give off eight pairs of nerves. Five of these, which are given off close together on the anterior lateral border, may be said to arise from the cerebral ganglion. The nerves numbered 2, 3, 5, 6 in the figure all give branches to the muscles around the mouth,

number 3 also going to the tentacle and the sub-pallial ridge, and 5 and 6 giving branches to a gland in the mouth muscles. Number 4 is a very small nerve which runs forward to the muscles of the body wall. The nerves of the pleural portion are three in number, the first two originating as one nerve which soon branches. They may be called the anterior (7), median (8), and posterior (9), mantle nerves, as they supply the whole length of the mantle. The main trunk of any of these mantle nerves lies in the body cavity, close to the body wall for most of its length, but finally passes through the body wall and lies near the large lateral blood sinus. Branches cross the body wall just below the large sinus, usually between it and one of its branches, and run along just outside of it, giving off branches to the papillæ. These branches usually originate near the branches of the sinus and the branches of both systems in the papilla are closely connected. The nerves that go to the papillæ are large and have some ganglion cells near their origin. They give numerous fibres throughout the length of the papilla, and finally terminate around the gland at the apex.

The pedal ganglia are situated below the posterior part of the cerebro-pleural and extend slightly beyond the lateral margins, so that they are usually visible from above. They are nearly spherical and measure about 250 microns in diameter. They are joined to the cerebro-pleural ganglia by two connectives, placed close together, the fibres of one passing to the cerebral and of the other to the pleural portion, and to each other by commissures which are closely connected with each other and with the visceral commissure for the larger part of their course, but have separate origins. The pedal ganglia give off a pair of very small nerves that run forward to the body wall (14), and anterior (15), median (16), and posterior (17) pedal nerve. These run along inside the muscles of the body wall at the angle of the side and foot, giving off branches with ganglionic enlargements, which branch and rebranch, sending fibres to the muscles, skin, and glands of the foot. They also give small branches to the muscles of the body wall at the side and foot. The pedal ganglia also give off another pair of

nerves, which differ in size and distribution. The one on the left side (13) is small and runs directly back to the body wall, while the one on the right side (11) is large and runs to the genital ganglion, one of the branches of which (12) corresponds in distribution to the whole left nerve.

The visceral ganglia are situated back of the pedal, just below the pleural, to which they are closely attached. The right is larger than the left (about 100 microns in diameter) but there is a distinct ganglion which sends a small nerve (25) to the mucus gland. This is a slightly different arrangement than any observed by Elliott, or Hancock and Embleton, as they figure only one visceral ganglion, the right, which they consider a fusion of the various visceral ganglionic centers. The right visceral ganglion sends off three nerves, as does the unpaired visceral ganglion of other species, but two of these are extremely small. The shortest (19) goes back along the albumen gland; to which it gives nerves and finally enters the liver-mass near the œsophagus. The next in size (20) gives off a branch (21) which goes in the direction of the genital ganglion, although I was not able to determine whether it actually joins this ganglion. The main nerve then continues back beside the posterior pedal nerve, giving off branches to the mucus gland, then changes its course, gives a branch to the intestine, and finally divides into two branches, one going to the hermaphrodite gland and the other to the nephridia. The largest nerve (18) gives branches to the aorta and blood gland, continues back beneath the heart, to which it gives a branch, gives branches to the nephridia, and nephridial valve, and finally joins the central ganglion of the branchial plexus.

The optic ganglia are very small (about 50 microns) ovoid, and attached to the upper surface of the cerebral by short connectives. They give off very minute nerves to the eyes.

The accessory nervous system was only determined in certain portions, since the nerves are very fine and run in a complex mass of muscles, connective tissue, and glands, and special methods could not be employed because of lack of material. The gastro-heptic plexus is apparently much reduced, as no

large ganglia, similar to the branchial and genital, were visible, such ganglia as appeared being very minute. The genital plexus is greatly fused, forming a single ganglion as large as one of the buccal ganglia, which gives off several nerves to the reproductive organs, as well as one nerve (12) to the body wall, which is apparently homologous with (13). The branchial plexus consists of several fairly large ganglia, which give off larger nerves than are found in other portions of the accessory system. The central ganglion receives a nerve from the visceral ganglion and branches from the posterior mantle nerve, these latter having passed through ganglia which give off branches to the heart and branchial region. The central ganglion gives off branches to the nephridia and the region around the intestine, and is joined to a small ganglion just above it, which gives nerves to the three branchiæ.

The Sense Organs. The otocysts are buried between the cerebro-pleural and pedal ganglia, just inside the cerebro-pleural and pleuro-pedal connectives. They are oval membranous capsules about 50 microns long, lined with a few much elongated cells. The otoconia appeared to be very small particles, but they may have been partly eroded by the acid used in the fixing solution.

The eye is nearly globular and slightly elongated from front backwards, where it measures about 75 microns. It lies in a mass of connective tissue somewhat in front of the optic ganglion, to which it is attached by a very small nerve. The coat of the eye itself is a thin, compact, connective tissue layer, much thinner in front than in back. The lens is nearly oval and in section appears to be formed of a thick capsule, containing an alveolar substance, or at least, a substance that condenses into globules after fixation. Back of this is a thick cap-shaped layer of pigment granules, and back of these and closely connected with them are a few cells of rather indefinate outline, containing large granular nuclei, very similar to the nuclei of some of the nerve cells. The whole appearance and location of the eye would indicate that it does not fulfill any very important function. It is not only situated below the

thick outer body wall, but surrounded by a mass of connective tissue as well. The nerve which it receives is extremely minute when compared to the nerve which goes to the rhinophores, for instance, and there is no organized retina.

The rhinophores are situated well forward and somewhat at the sides of the head. They consist of a stout central stalk divided transversely into twelve prominent leaves. The length of the central stalk is about 0.6 mm. in the contracted condition. When retracted, the rhinophores are completely withdrawn into a little cavity in the integument, the upper surface of the rhinophore being at a level with the opening of the cavity. In section it may be seen that the lamellæ are covered by an epithelium of tall, slender cells with small, darkly-staining nuclei in the basal portion. These cells appear to bear short cilia, but not nearly such prominent ones as those in some other places, as the foot. A very large nerve enters the stalk of the rhinophore and gives five branches to the lamellæ. Muscle fibres run up the sides of the stalk and these also send a few fibres to the lamellæ. The rhinophores are by far the most highly developed sense organs of *L. cockerelli.*

The tentacles and the sub-pallial ridge receive large nerves which end close to their upper surfaces, which are somewhat lamellated and bear a ciliated epithelium.

The Reproductive System. The hermaphroditic gland is a racemose gland extending over the upper surface of the liver, below and between the branches of the nephridia. It reaches down on both sides below the level of the papillæ and extends well over the caudal and cephalic ends of the liver. The spermatozoa develop in large follicles, each surrounded by several smaller ovarian follicles which open into it. The spermatic follicles open into small ducts which come together to form the large duct of the hermaphroditic gland. In all but one of the specimens examined, both ova and spermatozoa were developing. In that one the female organs were dormant and the ova had only just begun to develop. The ovarian follicles usually contain several ova in various stages of growth as well as small cells with a darker-staining protoplasm that were wedged in

between the ova around the edge of the follicle to form a sort of lining layer. These were probably undifferentiated ova and nurse cells. In the spermatic follicles columns of spermatogonia were usually found in the upper part and bunches of spermatozoa in the lower. Between these are columns showing several different stages. From the hermaphroditic gland extends a long slender duct to the ampulla. In all the specimens examined it was found packed full of spermatozoa. In the distended condition it is a large, pear-shaped sac, with a wall 10 microns thick. There is no epithelial lining layer, apparently.

From the ampulla extends a short, ciliated duct. It soon divides into two parts, the male duct, which is very small and lined with short cilia, and the larger female duct, lined with very long, strong cilia. This strongly ciliated duct is rather short and opens into a lamellated portion lined with ordinary short cilia. The lamellated portion divides almost at once into two parts, one leading to the spermatotheca, the other to the oviduct.

The duct to the spermatotheca, or rather from the spermatotheca, gradually becomes smaller and after a somewhat winding course enters a mass of circularly disposed muscle fibres, the arrangement of which would indicate that they act as a valve. In the center of this muscle mass is a small chamber from which three ducts pass,—the above mentioned duct which joins it to the oviduct, a duct to the spermatocyst, and a duct to the spermatotheca. The duct to the spermatocyst is small and the spermatocyst itself is a small, thin-walled, oval sac, lined with short columnar cells which appear ciliated although not prominently so in the preparations. In one animal sectioned the spermatocyst was empty, in the others it was packed full of spermatozoa and distended to twice or more than twice its size when empty. In the one animal in which the spermatocyst was empty all the female organs were dormant and ova were not developing in the hermaphroditic gland, while the glands of the male organs were active and spermatozoa were found in some of the passages; in all the other animals, the female organs were in a state of activity.

The duct from the spermatotheca is small and ciliated. The spermatotheca itself is a large, spherical sac, lined with long dark-staining, columnar cells. These have large, oval nuclei just below the free surface and in the resting condition (in the one specimen where the female organs were dormant) appear covered with a brown cuticle. In all the other specimens the cells lining the spermatotheca were much elongated and pouring forth a secretion. The spermatotheca was much more expanded in the active than in the dormant specimen and the epithelium over part of the surface usually appeared to be more or less broken down, perhaps due to the excessive secretion. This would make it appear that the spermatotheca is more than a mere resting place for the spermatozoa, the function which is ascribed to it by Alder and Hancock. The duct from the external opening to the spermatotheca leaves very near the opening of the duct from the spermatotheca to the oviduct. This is at first small but becomes larger and more strongly ciliated, and ends close to the opening of the penis in a small opening surrounded by a heavy ring of muscle fibres.

The oviduct in the dormant specimen appears as a tortuous channel lined with short cilia, surrounded by a mass of connective tissue, in which lie numerous branching glands. These are rather large sacs lined with dark-staining columnar epithelium, the nuclei of which lie at the base of the cells. In the dormant state these glands do not differ much from each other, but in the active state they become very much changed in appearance and differentiate into two types. One becomes very much larger, the cells becoming full of a homogeneous secretion and swollen to a length of 120 microns or more, the cell outlines become very indistinct, and the whole mass stains very faintly, although the nuclei stain very deeply. The other gland is small and lies in the center of the mass, and farther from the external opening than the other. It consists of branching tubes lined with columnar cells about 80 microns long and with rather a large lumen. These cells are sharply differentiated from those of the other gland by the fact that they stain deeply and the secretion is granular and is poured out into the lumen

in large droplets. I have not determined the exact relation of these glands to the oviduct, but in the dormant specimen the glands are separate and open into the oviduct by numerous channels, and in active specimens, for at least a portion of its course, the oviduct is separate. The oviduct ends in a large opening with folded walls, situated in back of and somewhat below the other two genital openings.

The male branch of the common duct is very short and opens into a large, thin-walled, convoluted, glandular sac. The walls of this sac are lined with columnar epithelium about 50 microns high, which seems to consist entirely of mucus cells. The upper portion of nearly all the cells is empty and presents the characteristic appearance of mucus cells, there being only a little protoplasm gathered around the spherical dark-staining nuclei at the base of the cells.

It is possible that these cells possess cilia, as there is usually a condensation of substance just beyond their upper borders, but this may be a secretion product, and, if it does indicate cilia, these cilia are very small and scanty. Near the end of the glandular sac, the cells at one side become changed in character. They remain about the same length as the mucus cells, but become more closely packed, so that the nuclei which lie at the extreme base, lie side by side, almost touching each other. The cells are full of dark-staining secretion for about half their length. The upper half is much less dense, but contains the same substance, which is being thrown off into the lumen, where it collects in droplets. This area of secreting cells gradually widens so as to include the whole of the end of the gland, which soon narrows down into a ciliated duct. The duct gradually decreases in size and the epithelial cells become shorter, while a surrounding layer of circularly placed muscle fibres becomes gradually thicker, until it passes into a tube, where it opens into a wide canal, lined with very short, strongly ciliated cells and surrounded by a heavy muscular wall. The external opening is large, and the lining membrane is thrown into folds.

SUMMARY

1. The muscular system consists of two parts, a layer lining the body cavity, and strands passing through the connective tissue to the foot, papillæ, and mantle.

2. The liver communicates with the stomach by numerous large openings. The whole alimentary canal is ciliated.

3. The kidney is a large sac, with many ramifications, lined with clear, cubical cells, on a very thin basement membrane.

4. The cerebro-pleural ganglia appear fused in a mass above, but below and in section show their separate origin. There is a small visceral ganglion on the left side, which sends off one nerve; and a larger one on the right, which sends off three. The gastro-œsophageal ganglia are completely fused with the buccal. The ganglia of the gastro-heptic accessory plexus are very small, those of the other plexuses are fused into a few large ganglia.

5. The blood from the posterior aorta passes to the liver mass and thence to the branchiæ before returning to the heart. The blood from the anterior aorta passes back through the lateral sinuses, being aeriated through the skin and especially in the papillæ.

6. The reproductive organs contain numerous glands. The male organs have a large, thin-walled accessory gland, lined with cells that appear empty in the sections, and a smaller gland, lined with tall cells full of globules of secretion material. The oviduct bears a large gland, the cells of which are swollen and full of homogeneous secretion; and within that a smaller gland with dark-staining granular cells. There are a spermatotheca and spermatocyst.

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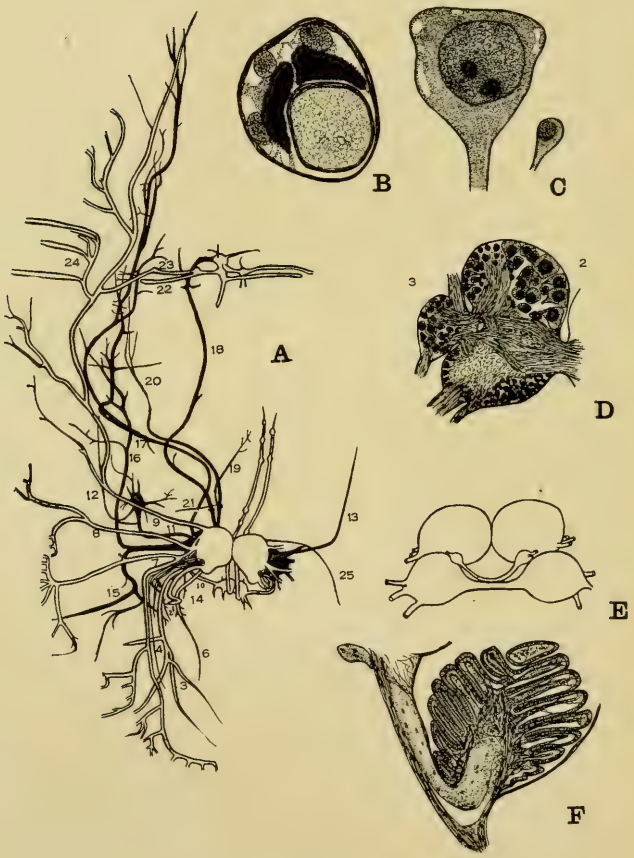

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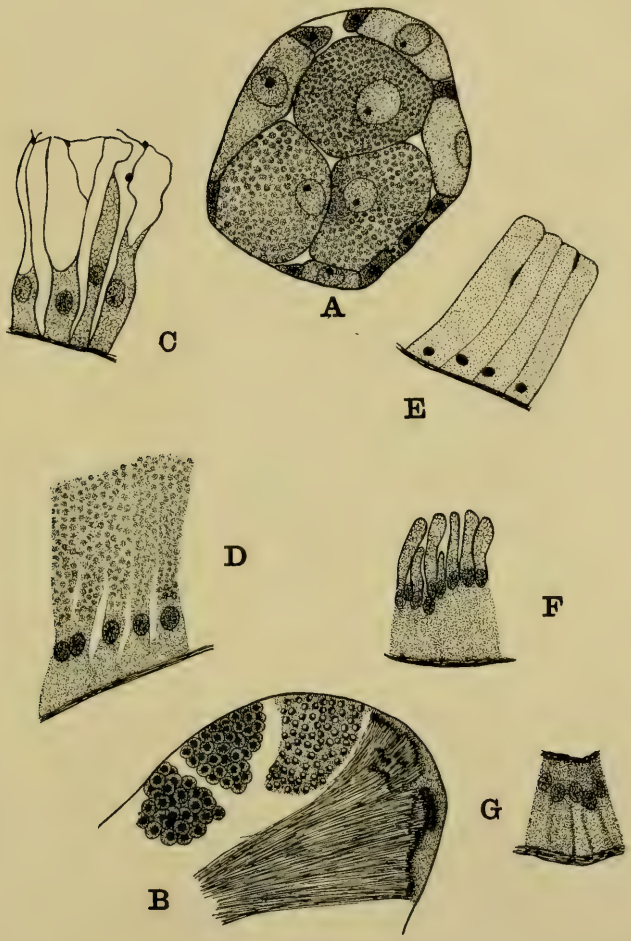

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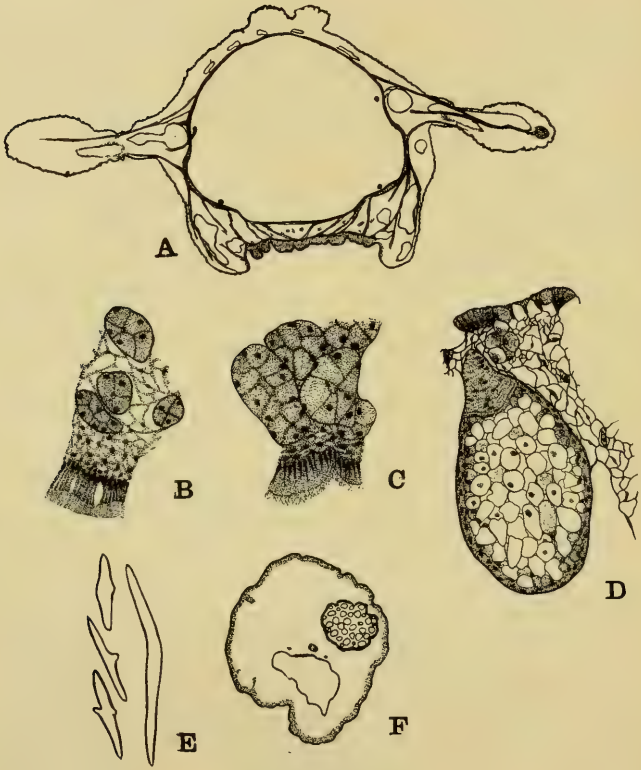

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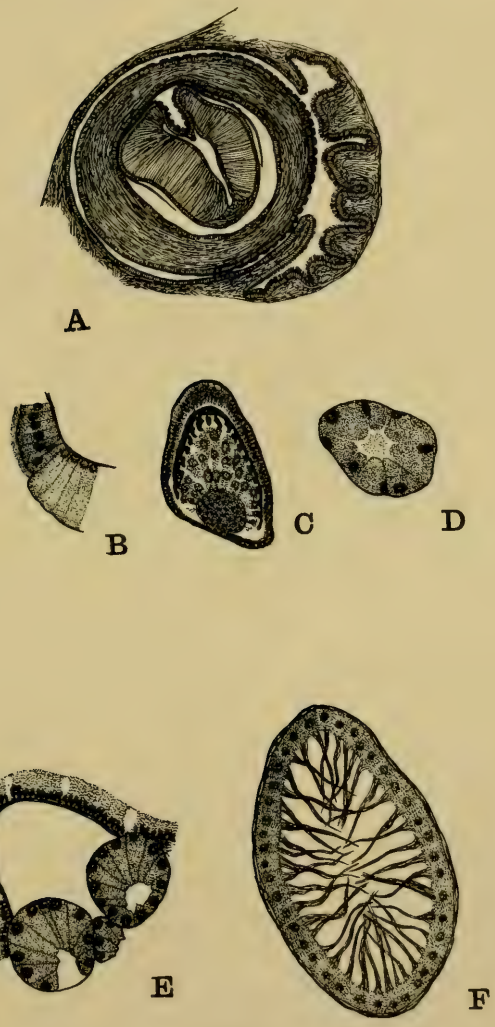

Figure 4

Figure 5

DESCRIPTION OF FIGURES

Figure 1. A, central nervous system X50; 1, nerve to rhinophore; 2, 5, to gland in buccal mass and muscles of mouth; 3, to mouth, tentacle, and subpallial ridge; 4, to body wall; 6, to mouth muscles; 7, anterior; 8, median; 9, posterior mantle nerve; 10, cerebro-buccal connective; 11, to genital ganglion; 12, to body wall; 15, anterior; 16, first posterior; 17, second posterior pedal nerve; 18, from visceral ganglion to branchial plexus; 19, to albumen gland and liver; 20, to mucus gland, intestine, etc.; 21, to genital ganglion (probably); 22, to branchia; 23, from posterior mantle vein to branchial plexus; 24, branches to papillæ. (in all other cases only the origin of the nerves to the papillæ is shown); 25, to albumen gland. B, eye; C, cells from central ganglion showing variation in size. D, section through central ganglia; 1, cerebral; 2, pleural; 3, pedal ganglion; E, the central ganglia; F, rhinophore in section.

Figure 2. A, ovarian follicle; B, spermatic follicle; C, gland cells from light portion of male accessory gland; D, cells from dark portion; E, cells from albumen gland (female); F, active; G, dormant cells from spermatotheca.

Figure 3. A, cross section body wall; B, gland cells from foot; D, gland of papilla; E, spicules; F, cross section of papilla.

Figure 4. A, cross section buccal mass; B, point of junction of stomach and liver epithelium; D, cross section salivary gland; E, tip of branchia; F, nephridial valve.

Figure 5. Reproductive system. Hermaphroditic portion striped, female dotted, male plain.

The Collector's By-Product

XIMENA MC GLASHAN
Truckee, Cal.

Present methods of collecting Lepidoptera could be improved just as the great packing houses have improved the meat business, by utilizing the by-product. Expressed differently, the battered and unsalable female moths and butterfles which the collector throws away can be made to produce more perfect specimens than his entire catch. Of two females of a species unknown to science, I prefer one that is slightly damaged to one which has just emerged from pupa. The latter counts one perfect specimen, the former probably contains fertile eggs and may produce hundreds of perfect specimens.

Entomological works are strangely silent as to the utter simplicity and untold value of propagating Lepidoptera. They instruct the collector to use the net, search for eggs, larvæ and pupæ, sugar for moths, use traps and visit lights, beat bushes, and all that, but fail to tell him that a battered female will nearly always lay eggs if placed in a paper bag or box. Edwards, Scudder and all the great authorities give minute descriptions of larval transformations, but fail to state that collectors could indefinitely multiply their output by obtaining eggs from each desirable variety by saving the usually discarded females. Writers of Nature books tell of the great difficulty they had in finding eggs of certain varieties when all they had to do to obtain them was to imprison a slightly worn female.

A female *Catocala* has been known to oviposit fourteen hundred fertile eggs. The resulting adults, if propagated and equally prolific, would produce half a million eggs. Artificial propagation of fish yields such wonderful returns that it seems incredible that no writer has advocated the same methods in obtaining quantities of perfect butterflies and moths. My father has been my teacher, and he learned under the direct tuition of Harry Edwards and W. H. Edwards, forty years

ago. I am only nineteen years old and began entomological work July 15th, 1912, but in eleven weeks last year I caught, bred and sold to Dr. William Barnes of Decatur, Illinois, eleven thousand five hundred specimens.

All the moths and about one-half of the species of butterflies will oviposit in boxes and bags and many kinds do not even require food. If the imprisoned female demands food, place daily in her prison house a bit of dried apple soaked in water sweetened with honey. With the varieties mentioned there is no other work or worry. Larvæ and pupæ resulting from the eggs thus obtained will be safe from the ravages of parasites, and the method of rearing them is fully described in the books. What the books do not tell is that with these varieties there is no trouble in getting eggs. The entire story may be told thus: Put your unsalable females in paper boxes and bags and feed them if necessary.

About half the species of butterflies require the presence of the living plant upon which their larvæ feed else they will die without laying eggs. W. H. Edwards confined them in nail kegs covered with gauze and placed over the plant. Ordinary paper bags tied over sprays of the living plant are less cumbersome and fully as satisfactory. It is necessary, however, to know the foodplant. I have printed charts of all the known foodplants of butterflies and moths, and will send them postage paid to any person interested, upon application. I want additions and corrections for future, perfected charts. It is my aim to sometime produce perfect lists of foodplants for all Lepidoptera and I shall certainly fail if collectors and scientists do not assist me.

If you do not know the foodplant of the larvæ which hatch from the eggs of a given female, you at least know it grows in the locality where you found the female. If you discover the foodplant you have added an atom to scientific knowledge. Place on the tin lid of an inverted jelly glass the newly hatched larvæ and narrow slices of twenty different leaves. If they eat any given leaf you have found a foodplant which will answer temporarily, but it is well to introduce another and another

score of slips until you have discovered their favorite. It is not a difficult thing, usually, to find something suitable. If you know the foodplants of other members of the family your species will probably accept leaves of these plants. The scientist wishes to know the natural foodplant of each species, but the butterfly farmer is content if he finds "something just as good." The natural foodplant exists in the region where the insect is found. You have a great advantage, therefore, over the distant scientist who attempts to rear the larvæ in a different zone, perhaps, and without the slightest clue as to its natural preference, yet the scientist often succeeds. Even beginners, like myself, are glad to receive shipments of eggs accompanied by the mother insects.

I do not minimize the distracting difficulties of propagating certain species of Lepidoptera, but I boldly assert that there is no difficulty at all with the majority, the vast majority of species. Where the beginner makes one failure he will make many successes. Always remember that the rarest species are generally as easily propagated as the commonest, that all will lay their eggs if they have an opportunity, and that butterfly farming does not interfere at all with your collecting, for you are utilizing the by-product, the damaged females of your catches. With ever so little outlay of time and trouble you will multiply your output a hundredfold.

During the past year I have corresponded with over a thousand people who are eagerly interested in butterfly farming, and I have taught its elementary principles to hundreds of enthusiastic pupils without asking any compensation except gratuitous offerings of specimens from each locality. At any time I should be glad to correspond with those interested in this work.

Studies in Laguna Beach *Isopoda,* II

BLANCHE E. STAFFORD, M.S.

Nearly everyone who frequents the seashore and is half alive to the many opportunities which the water, rocks and sand offer in a study of the manifestations of life which they can reveal, has become acquainted with the form and habits of such crustaceans as the lobsters, crabs and shrimps. There are very few, also, who do not know the lively little sand-fleas which populate so thickly the sandy beach. Not many realize, however, that these latter are relations of the big lobster and crab, as they are, and that they are of myriad forms and habits; that they live not alone in the sand, but in the shallow pools, under rocks, on the sea mosses and in the deep waters. But still less do they know of the Isopoda, the near neighbors of the sand fleas, or Amphipoda. It is with certain Isopoda, relatives of the lobster and crab and sand-flea, that this paper deals. The reason we know so little, as casual observers, of these little creatures is that they are very secretive and love to hide themselves in obscure places; their characteristic manner of crawling, instead of hopping as do the Amphipoda, makes them less conspicuous than the latter. But they are in reality very numerous and most interesting in the variety of forms they exhibit. To know them one has only to catch them at the proper time and place and to ferret them out of their retreats. Frequent the beach at a time when the tide is fast advancing and you will see along the line left by the receding water whole hosts of these little crawlers, scurrying out of their holes for the high and dry sands. Go in the very early morning when the tide is at its lowest mark to the mossy rocks which lie uncovered then. As you turn them over one by one you will find many interesting things, among them numbers of amphipods that slide around on their sides, and a great plenty of very active isopods. You may gather some of the moss on the rocks and with the help of a hand lens find that it is peopled with minuter forms which you cannot see without this careful scrutiny. And

there are still many other places in which some one or another of this isopod group dwells. Some are securely fortified within the minute chambers of the sponges; some are tube builders or excavators; some have sought the crevices of the big dry rocks where they neighbor with the shore crabs; and some are even fond of the muddy shore of a stagnant lagoon; still others inhabit the gill chambers of fish or crabs, living a parasitic and degenerate life. Though many of the Isopoda are marine there are also many terrestrial and fresh-water forms, the former known to most of us by their representative, the common sow-bug, or wood-louse, or pill-bug, as it is variously called.

Not less interesting than the numbers and habitat of these animals is their diversity in color and form as adapted to their environment. Those inhabiting the sandy and rocky places are provided with a chitinous crusty structure and are colored a dull gray or brown which favors well their characteristic love for obscurity. Those which dwell in the pools or on the moss are more delicate and are provided with special swimming organs. On the green Algæ there are elongated isopods, green in color and hardly distinguishable from the moss on which they occur, and similarly brown forms on the brown Algæ. A most interesting instance of these color adaptations which I observed in my study at Laguna Beach was that of an isopod which dwells on the oral surface of a sea urchin; it was a dark reddish-purple in color, so very like that of its host that one could scarcely distinguish it when at rest. Much might be said of the diversity and beauty of color of the marine Isopoda, but that is a study in itself.

It appears that the Isopoda and Amphipoda are somewhat closely related, since both can be grouped under the more limited division, Arthrostraca. They differ from each other as follows: the Isopoda are dorso-ventrally flattened, the Amphipoda laterally compressed. There are other differences such as modified second and third thoracic appendages and a differentiation of abdominal segments into two sets in the Amphipoda. A common and popular distinction is the crawl-

ing habit of the isopod and the hopping habit of the Amphipoda. Such a distinction is not entirely valid however, since neither of these characteristics is common to all the forms of either group.

The Isopoda body is differentiated into: (1), a head having sessile, usually compound eyes which may be contiguous or distant; antennæ of two pairs, generally; a set of delicate mouth parts, consisting of an upper and lower lip, two pairs of maxillæ, a pair of mandibles and a pair of maxillipeds; (2), a thorax of seven segments of similar structure, each bearing a pair of legs; the legs are often similar, a characteristic which led Latreille to name them Isopoda from two Greek words meaning "equal" and "foot". Latreille, however, was not acquainted with the many exceptional forms such as the modified first leg for grasping purposes or the posterior swimming legs found in some species; (3), an abdomen consisting usually of six segments, five of which bear pleopods (respiratory and natatory organs); the sixth with a pair of uropoda (natatory organs). The Isopoda do not develop through a series of larval stages but through direct development. The females are provided with marsupial plates which form a brood pouch in the sexually mature individual.

After a careful study of the complicated and finely adjusted structure of these creatures one must have gained a great respect for them and for the complete and perfect results which nature has here effected. Add to this study a knowledge of the actual service rendered by the Isopoda in the economy of nature and one's interest in them will be increasingly greater. Have you ever stopped to consider how very rich in life the sea is, with its multitudes of marine plants and animals? Have you further considered how many of these forms are constantly being destroyed in one way or another and subject to the processes of decay? If so, you have often wondered how the sea is kept ever sweet and pure. For a solution, in part, of this question I would ask you to turn to the isopods and their associates, the amphipods. These small animals, many of them almost microscopic in size, are the scavengers of the waters and it

is their service to remove the waste of ocean life. The latter are free swimmers and in their wanderings scour the surface of the waters. The former usually remain close in their native haunts and it is they who purify the substrata of the sea. Not here does their service end. So abundant are they that they form a part of the food of many fish and thus they are indirectly food providers for men. To these ends the Isopoda are very widely distributed. They are most abundant in the northern waters. Thence they extend in varying numbers to the warm southern waters and the temperate shores and from east to west. So great is their importance that we dare not speculate as to the state of unstable equilibrium in nature which their sudden and thorough destruction would cause. Suffice it to say, that at present no such calamity is pending, for the isopods are a mighty throng and well equipped by nature to survive.

In the studies which follow I have described and illustrated twelve species collected at Laguna Beach, California, in the summer of 1911. One of these is a new species, two are new varieties. A number of the others, although noted before, have not been illustrated at all before or if so not at all completely.

List of the Species Represented in this Study

Superfamily FLABELLIFERA

A. Family CIROLANIDÆ

Genus *Cirolana*

Cirolana harfordi (Lockington)

B. Family SPHÆROMIDÆ

Genus *Dynamene*

Dynamene glabra Richardson

Superfamily VALVIFERA

A. Family IDOTHEIDÆ

a. Genus *Idothea*

Idothea rectilinea (Lockington)

b. Genus *Pentidotea*

Pentidotea aculeatus n. sp.

Superfamily ASELLOTA

B. Family JANIRIDÆ

a. Genus *Janira*

Janira occidentalis Walker

Superfamily ONISCOIDEA

A. Family TYLIDÆ

a. Genus *Tylos*

Tylos punctatus Holmes and Gay

B. Family ONISCIDÆ

a. Genus *Alloniscus*

Alloniscus cornutus var. *lagunae* n. var.

Alloniscus perconvexus (Dana)

b. Genus *Philoscia*

Philoscia richardsonae Holmes and Gay

Cirolana harfordi (Lockington)

(Figs. 1, 2, and 3)

Locality—Very abundant under rocks between tides, at Laguna Beach, California.

Color—Great variation, some white with gray markings, some shaded with yellow or orange; females bearing eggs often show a bright red coloration; in alcohol the specimens always appear to be a sordid white marked with gray.

Body ovate, arched transversely and longitudinally. Specimen described measures 7 mm. by 3 mm. Head wider than long, 2 mm. by 1 mm.; rounded on anterior margin. Eyes small, composite, situated laterally and touch anterior margin of first thoracic segment. First pair of antennæ have a peduncle of three articles of which the first and second are small and subequal; third almost as long as first and second and narrower; flagellum of ten articles. Second pair of antennæ have a peduncle of five articles: first three small and subequal;

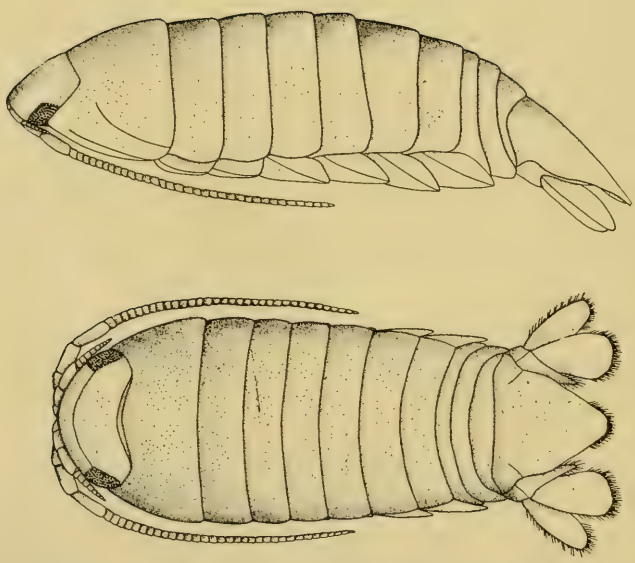

Figure 1. *Cirolana harfordi* (Lockington). Lateral and dorsal views.

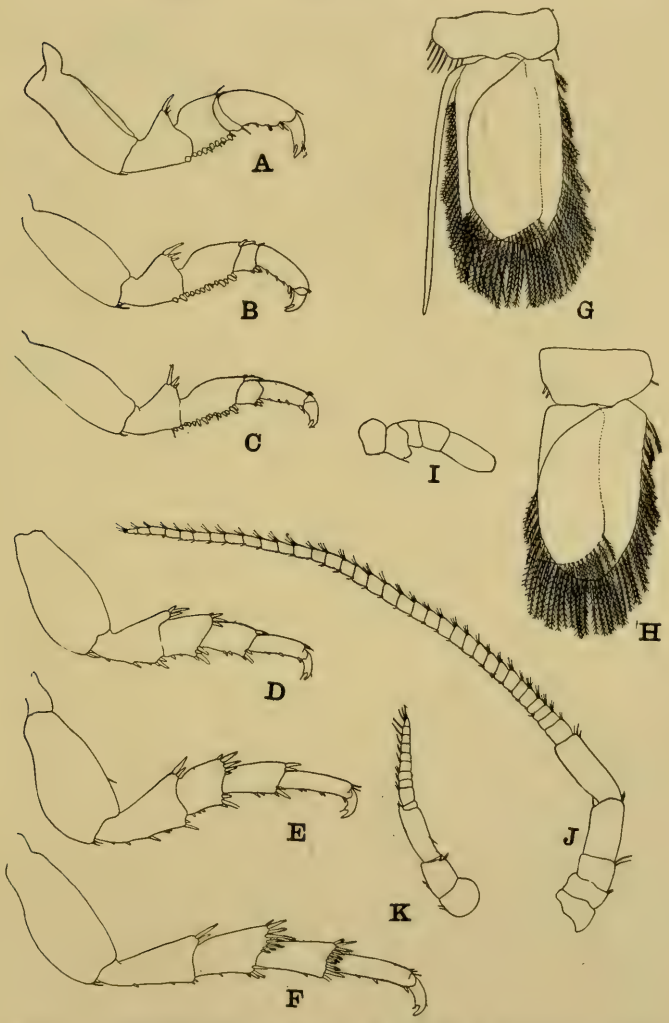

Figure 2. *Cirolana harfordi* (Lockington). A, first leg; B, second leg; C, third leg; D, fourth leg; E, fifth leg; F, seventh leg; G, second pleopod of male; H, first pleopod of male; I, frontal lamina and basal joints of antennæ; J, second antennæ; K, first antennæ.

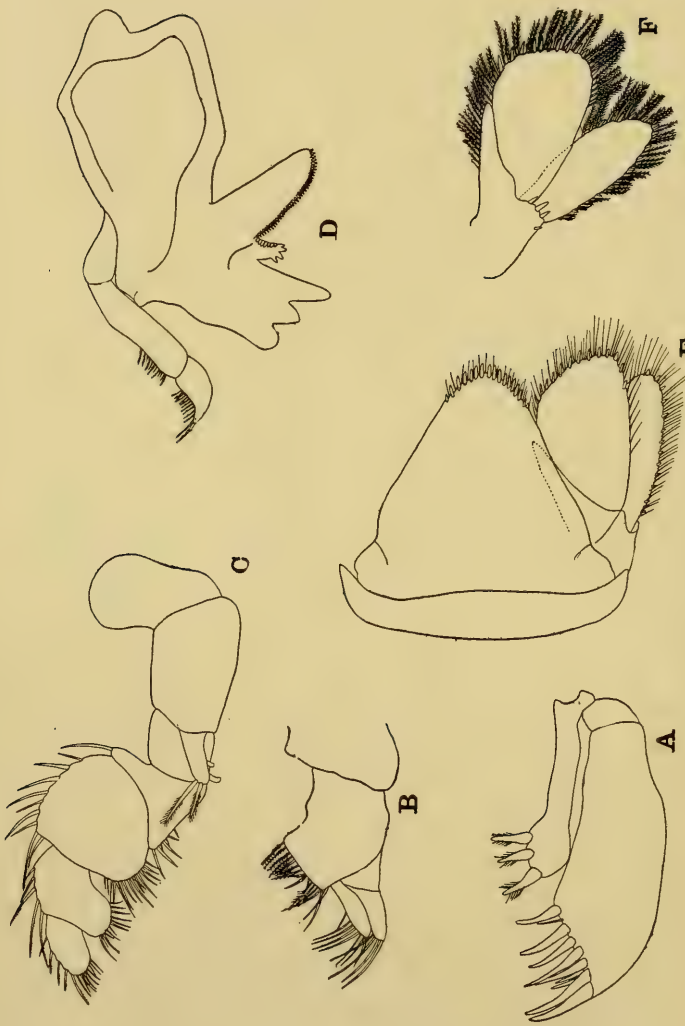

Figure 3. *Cirolana harfordi* (Lockington). A, first maxilla; B, second maxilla; C, maxilliped; D, mandible; E, telsen; F, uropod.

fourth about twice as long as wide, about as long as second and third; fifth about one-fourth longer than fourth; flagellum multiculate, thirty-four articles. First antennæ extend to end of peduncle of second antennæ; the latter extend to end of fifth thoracic segment. Maxilliped composed of seven articles; the last four very plumose; third is provided with two hoops or blunt spines. Mandible carries a palp of three articles and a toothed molar. Frontal lamina, distinct, short and broad, anterior margin triangulate though not sharply so.

First segment of thorax large, twice as long as third and fourth segments. Succeeding segments almost equal in length, though second is very slightly longer than third and fourth. Epimera are very distinct on all but first segment. Last four are produced at post-lateral angles especially the sixth and seventh. A carina is apparent on all the epimera, longitudinal in the first two and oblique in the last four. First three legs prehensile, remaining ambulatory. On propodus of first there are three prominent spines; one on the carpus; on the merus seven prominent blunt spines and about three sharp ones; ischium has one blunt spine like those of the merus, also a large spine on the outer distal margin. Second leg has three or four spines on the propodus; three on the carpus; eleven blunt spines on the merus and two spines on outer distal margin; ischium has two blunt spines, one large and two small ones on outer distal margin. Ambulatory legs provided with many robust spines.

Abdomen in the specimen described shows only three segments, four or five may be visible, however, but first is usually concealed. Sixth broad at proximal end, attenuated posteriorly; apex rounded, provided with many strong spines, twelve to twenty-two. Inner branch of uropoda as long as terminal abdominal segment; broad at distal end where it is armed with spines. Outer branch is shorter than inner and narrower; also armed with spines on distal end and outer margin. Peduncle of uropoda produced to two-thirds length of inner ramus. First and second pleopoda of male provided with many compound hairs; second has a long stylet.

Alloniscus cornutus var. *lagunae* n. var.

(Figs. 4 and 5)

Locality—Margins of stagnant salt lagoon; under old sea-weed where it is associated with *Philoscia richardsonae* Holmes and Gay, at Laguna Beach, California.

Color—Dull gray-brown, resembling the old sea-weed under which it lives.

Body convex, ovate and punctate; about 10 mm. long and 5 mm. wide, 3 mm. high (dimensions of a large specimen).

Figure 4. *Alloniseus cornutus* var. lagunæ n. var.

Head not closely articulated with thorax; frontal margin produced medially into a prominent lobe; antero-lateral angles form distinct processes, much more prominent than in *Alloniscus perconvexus*. Eyes oval compound, longer than wide; near lateral margin. First antennæ have three articles, which are very small, rudimentary. Second antennæ extend about as far as second thoracic segment; have a peduncle of six articles and

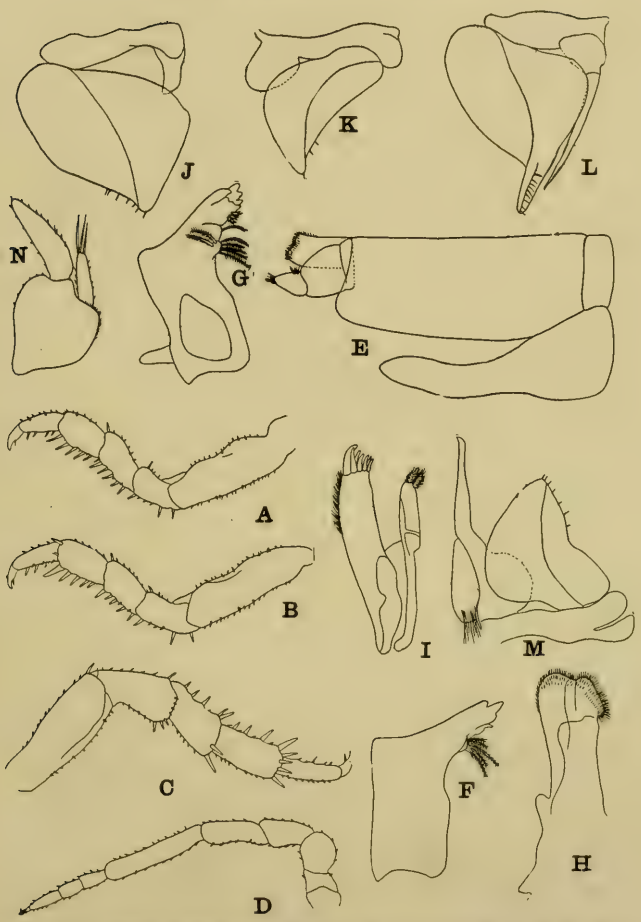

Figure 5. *Alloniscus cornutus* var. lagunæ n. var. A, first leg; B, second leg; C, seventh leg; D, second antennæ; E, maxillipeds; F and G, mandible; H, second maxilla; I, first maxilla; J, second pleopod of female; K, first pleopod of female; L, second pleopod of male; M, first pleopod of male; N, uropod.

a flagellum of three; flagellum about as long as fifth article of peduncle. Maxilliped has a palp of three articles.

The thoracic segments show no sinuations as described in *Alloniscus cornutus*. Epimeral sutures are only faintly indicated in some of the specimens on the second, third and fourth segments. Legs similar in structure and very much spined.

Abdomen has six segments; first two covered laterally by seventh thoracic segment. Epimera of third, fourth and fifth, large, extended posteriorly; subtetragonal in shape. Sixth, triangular, rounded posteriorly. Uropoda have basal article broad and depressed; outer ramus twice as long as inner which articulates at the inner angle of the basal article and is concealed at articulation by last abdominal segment. The outer ramus does not appear to be carinated.

These specimens evidently lie close to *Alloniscus cornutus*. Their peculiar habitat and associations should be significant. As the specific habitat of *A. cornutus* is not given it is impossible to compare them on this point. However, *A. cornutus* is described as having sinuated thoracic margins. Such is not the case with these specimens. The outer ramus of the uropoda does not appear to be carinated in this isopod as in *A. cornutus*. The flagellum of the second antennæ of the latter is shorter than the fifth article of peduncle, several specimens of this variety were examined and the flagellum appears about equal, scarcely less than fifth article. Accordingly I have made these specimens, provisionally, a variety of *A. cornutus*.

(Continued in the next number of the Journal)

Book Reviews

THE CLIMATE AND WEATHER OF SAN DIEGO, CALIFORNIA, by Ford A. Carpenter, local forecaster. Illustrated with photographs and charts by the author and others. Published by the San Diego Chamber of Commerce, 1913. 118 pages.

The following quotation from Humboldt is seen on the title page: "The term climate, in its broadest sense, implies all the changes in the atmosphere which sensibly affect one's physical condition." That is probably the best definition of that word. And we know that all the forms and colors of animals—the evolution of animal life—are due directly or indirectly to the environment; so a study of the elements in the environment of animals is necessary for the naturalist, if he wishes to really know about his subjects of study. And the various parts of the environment are due largely to the temperature and other weather conditions.

There are 27 short chapters dealing in a clear way with various meteorological subjects, just what a biologist in this region should know. There are 15 full-page and instructive plates and 12 suggestive and useful charts in the text; there are 15 tables showing meteorological conditions over a series of years, and these will prove especially useful to students in correlating insect periodicity and other phenomena which are hardly understood. The plants and animals, as is well known, are more prone to vary in every direction in California than in any other state. This is due, in part, to the great diversity of climate; the numerous mountain ranges and isolated valleys. There are three distinct climates within San Diego county—the nearly sub-tropical coast climate of the bay region, the climate of the mountainous district and the desert climate of the far east. Of course there are many other conditions which have to be taken into account; and only a close perusal of this book and McAdie's Climatology of California could show these. Climatology will be the next study for the student of geographical distribution and species formation.

F. GRINNELL, JR.

A REVIEW OF AN OLD BOOK

On the Variation of Species, With Especial Reference to the Insecta; Followed by An Enquiry Into the Nature of Genera, by T. Vernon Wollaston, M.A., F.L.S., London: John Van Voorst, Paternoster Row, 1856. Pp. VI+206.

I believe that it is about as profitable, nowadays, to read a book which is a half a century or more old than many of those which are coming off the press. I can nearly say with someone else: "When I hear of a new book I go to my shelves and take down an old one." This applies more especially to those on the philosophy of nature. The author of this book is well known for his work on the insects of the Madeira Islands, and his philosophy grew from this study of geographical distribution. The numerous examples are taken mostly from the Coleoptera, a few from the Mollusca. The index is an ideal one—modern ones could well be patterned after it—and gives some idea of the wealth of fact, observation and deduction to be found in the book,—a book just bristling with pertinent suggestions even for study for the modern naturalist. This book was published three years before the "Origin of Species." He lays special emphasis on minute variations of size, sculpture, color, etc., when constant and correlated with differences of habitat. His discussion and proof of the influence of isolation and environment on the change of specific form is as clear as stated by more recent authors. All is supported by his careful observations on the Coleoptera of the Madeiras, and material from other naturalists in other parts of the world, notably Darwin in South America, to whom he dedicates the book. His remarks in regard to color dimorphism of certain beetles, living and fossil, is very suggestive. "It is almost needless to add, that there are *many* elements to be considered, such as local atmospheric conditions, excess or deficiency of electricity, superabundant moisture, diminished light, and the geological composition of the soil, before we can hope either to appreciate zoological phenomena as a whole, or to reconcile the apparent inconsistencies which they are accustomed to display." —p. 47.

"The more we look into the question, whether by the light of analogy or the evidence of facts, the more are we convinced that lines of rigid demarcation (either between genera or species, though especially the former) do not anywhere, except through accident, exist. And hence it is that we ascend, by degrees, to a comprehension of that unity at which I have already glanced; and we are led to believe that, could the entire living panorama, in all its magnificence and breadth, be spread out before our eyes, with its long-lost links (of the past and present epochs) replaced, it would be found, from first to last, to be complete and continuous throughout,—a marvel of perfection, the work of a Master's hand."—p. 179.

It is a good thing to become acquainted with some of the older naturalists and their ways of working.

Fordyce Grinnell, Jr.

News Notes

FORDYCE GRINNELL, JR.

"A very small amount of information gained by the student in the field of Nature is sufficient to kindle the desire to increase it. The more we know, the more we are anxious to know; though the less we seem to know. It is one of the distinctive privileges of the naturalist that he has to labour in a mine which is inexhaustible: the deeper he digs beneath the surface, the richer is the vein for excavation, and the more interesting are the facts which he brings successively to light."—*T. Vernon Wollaston,* 1856.

Mr. Paul Kibler, a collector of natural history specimens in the Pacific Islands and South America, spent the past summer at Long Beach. He has gone to the Solomon Islands.

Mrs. W. W. Gnash, of Wenden, Arizona, is collecting some interesting insects, especially Lepidoptera, in that interesting but little known region.

Dr. Anstruther Davidson, of Los Angeles, spent the month of July at Bishop Creek, Inyo county, on the western side of Owen's Valley, collecting plants and insects.

Mr. R. L. Beardsley, secretary of the Southern California Academy of Sciences, collected insects in the Southern Sierras along Kern River and the headwaters of the Tule River, the past summer, and has taken some interesting beetles, including *Omus.*

The Lorquin Natural History Club, for young naturalists, named for the pioneer collector of California insects, has been organized in Los Angeles, and promises to become a fine association of rising naturalists.

A card from Mr. W. M. Mann, the active, energetic collector and student, well-known in California, reports "good collecting here," July 11, in Southern Mexico. He will doubtless have some interesting insects to report to the Entomological World.

Mr. Wilhelm Schrader is now doing some significant experimental work with the dimorphic *Colias Eurytheme* females, at

his experimental station near Los Angeles. A long paper on experiments with *Junonia cœnia* is in the July Bulletin of the Southern California Academy of Sciences.

Mr. Victor L. Clemence, of Pasadena, on a trip to Mt. Wilson in early August, collected a series of the interesting *Lycœna neurona Skinner,* of which something further will be said concerning the dimorphism or non-dimorphism.

Dr. Frank C. Clark, of Los Angeles, spent his vacation in the San Bernardino mountains, and collected a great quantity of insects of all orders, mostly Hymenoptera; including some interesting Mutillidæ and stylopized wasps.

In the July Sierra Club Bulletin, Prof. V. L. Kellogg, of Stanford University, has an interesting illustrated article on Butterflies of the Mountain Summits.

"An insect much resembling the June bug, and found in great quantities in the high plains about Quito, the capital of Ecuador, is toasted and eaten as a delicacy by the natives of that country. They are sold in the streets in the same manner as are chestnuts in the cities of this country. The roasted bugs taste very much like toasted bread."—The San Francisco Argonaut, April 26, 1913.

Prof. C. F. Baker, former editor of the Journal, now of the University of the Philippines, has an interesting article in the Philippine Journal of Science, April, 1913, entitled: "A Study of Caprification in *Ficus Nota.*" He gives, first, an account of the marvelous symbiotic relations of the fig-insects and the figs, and their guests and parasites. He describes a new *Blastophaga nota,* a new genus *Agaonella larvalis* n. sp., and five other new species in other genera, and a synopsis. The paper is illustrated by drawings of different structures; and is a valuable addition to the extensive literature of the subject.

A New Eriococcus

E. O. ESSIG

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SACRAMENTO, CALIFORNIA

Eriococcus cockerelli n. sp.

Description—The adult females are enclosed in a thin, felt-like, nearly globular sac varying in color from pure white to pinkish and averaging three-sixteenths of an inch in diameter

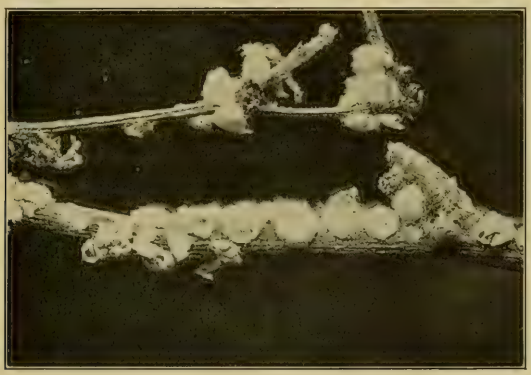

Figure 1. *Eriococcus cockerelli* n. sp. Adult females *in situ* on twig. Twice enlarged. (Original).

(Fig. 1). The body is oval in shape being slightly longer than broad and distinctly convex on the upper surface. The color of the dried specimens received is deep purplish red, turning cardinal when first boiled in K O H but subsequently becoming colorless and perfectly transparent excepting the spines, legs, mouth-parts and antennæ which remain light brown or amber. The body is thickly covered with stout spines, there being three common sizes (Fig. 2, B) of the following lengths: 0.05 mm., 0.037 mm. and 0.028 mm. The length of the type specimen is

2.5 mm., width 1.9 mm. Many other adult female bodies were measured and the largest was 3.2 mm. long and 2.4 mm. wide, while the smallest was scarcely half as large. Antennæ (Fig. 2,

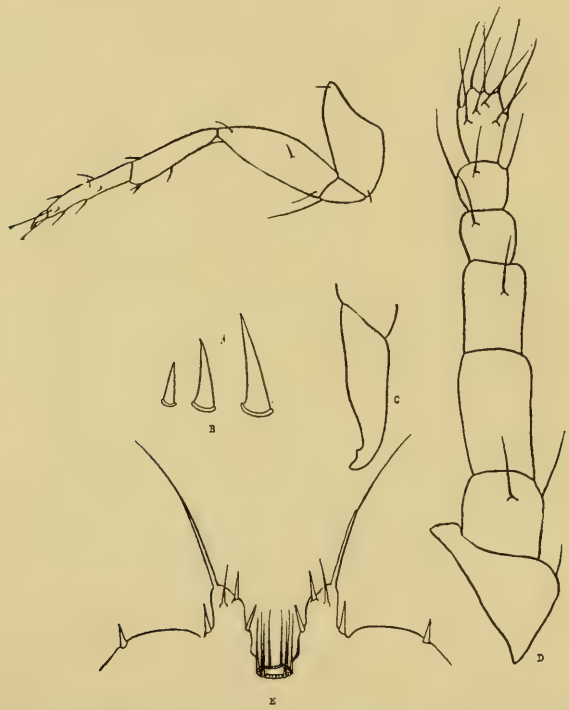

Figure 2. *Eriococcus cockerelli* n. sp. Left metathoracic leg. B, three common sizes of body spines; claw showing denticle; D, antenna; E, pygidium. All enlarged. (Original).

D) seven jointed, not very hairy and length of joints variable. The formula and measurements of the type specimen are as follows: III, 0.05 mm.; IV, 0.04 mm.; VII, 0.031 mm.; II, 0.03

mm., I, 0.025 mm.; V, 0.025 mm.; VI, 0.024 mm.; making the total length 0.225 mm. The following variations have been noted:

III, (IV, II, VII), I, (V, VI)
III, VII, (IV, II), I, VI, V
III, IV, II, (I, VII), V, VI
III, (IV, VII, II) I, (V, VI)

Legs (Fig. 2, A) large with few stout spines. Femora always longer than the tibiæ. Comparative lengths of the tibiæ and tarsi variable. Without considering the claw, either may be longer or they may be coequal. With the claw, the tarsus is always longer. The claw (Fig. 2, C) is only slightly curved and has a very small but distinct denticle on the inside near the tip. Digitals are long with large knob. Anal lobes (Fig. 2, E) distinct with long spine and four short stout spines on each. The eight circumanal spines are less than half as long as the long spines on the anal lobes.

Habitat—Nacon Chico, Sonora, Mexico.

Host—Reported on "Chino". As this is the Spanish word for quinine the plant probably belongs to the genus *Cinchona*.

Collector—Taken by Prof. C. H. T. Townsend May 1, 1911, and sent by him to Dr. T. D. A. Cockerell, who kindly forwarded the material to the writer. The species is named after Dr. Cockerell, who has on numberless occasions rendered valuable aid to the author's work on scale insects.

Studies in Laguna Beach Isopoda II B

BLANCHE E. STAFFORD, M. S.

Tylos punctatus Holmes and Gay

(Fig. 6)

Locality—Found in the sand at Laguna Beach; on being alarmed they rolled up in a compact ball.

Color—Gray, spotted with white.

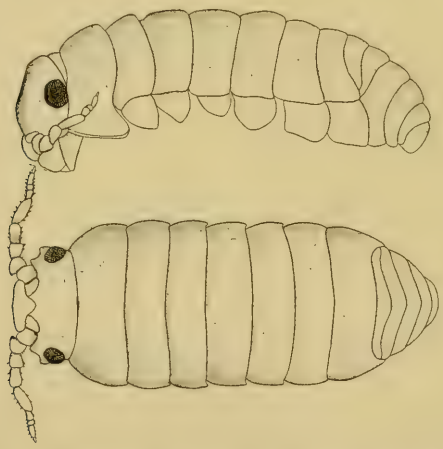

Figure 6. *Tylos punctatus* Holmes and Gay. Lateral and dorsal views.

Body oblong and very convex, manifesting very perfect ability to contract in the form of a ball. Covered with many minute spines. About twice as long as wide, 7 mm. by 3 mm. (measurements of a small specimen).

Head with lateral lobes produced into triangular projections in front of eyes. Eyes round and composite, situated postlaterally. First antennæ rudimentary, scale like. Second antennæ has peduncle of five articles: first three broad; first and

second subequal in length; second slightly shorter and has sharp projection on proximal inner angle. Fourth and fifth long and narrower; fifth, one and a third times longer than fourth. Flagellum composed of two short articles, a third equal to one and two, and a fourth short and conical. Antennæ profusely covered with spines. Extend scarcely to end of first thoracic segment.

Thoracic segments subequal: first slightly longer than those succeeding. Sutures of epimera distinct on all but first segment where epimera are indicated by a thickened margin. Epimera produced posteriorly and rounded. Legs ambulatory, all similar, very thickly spined. First leg has segments broader than those of following legs; first segment has a triangular process on exterior distal margin.

Abdomen composed of six segments. First two have lateral margins covered by seventh thoracic segment. Third broad, articulating with epimera of seventh thoracic segment on lateral margin, fourth rounded on lateral margin, slightly produced posteriorly as also the fifth which, however, is shorter and narrower. Sixth is truncate, short and broad. Uropoda have become opercular valves and have a short setose terminal joint.

Janira occidentalis Walker

(Fig. 7)

Locality—Large kelp holdfast from deep water, at Laguna Beach, Cal.

Color—White tinged with green and orange, finely spotted with brown; legs white.

Body about three times longer than wide, 6 mm. by 2 mm. Oblong, depressed along lateral margins. Slightly convexed on median line.

Head twice as wide as long, anterior margin not straight but produced into a slight median lobe; antero-lateral angles marked. Eyes large, round, composite and subdorsal in position. First antenna has first article of peduncle large, broad and long. Second and third subequal and much narrower than first. Fla-

gellum composed of twelve articles. Second antenna has first two articles subequal; third slightly larger, provided with antennal scale; fourth narrower and shorter than third; fifth and sixth long and narrow; sixth longer than fifth; flagellum multi-articulate. Maxillipeds with palp of five articles; first three subequal in width; fourth and fifth about half as wide. Mandible has a palp of three articles.

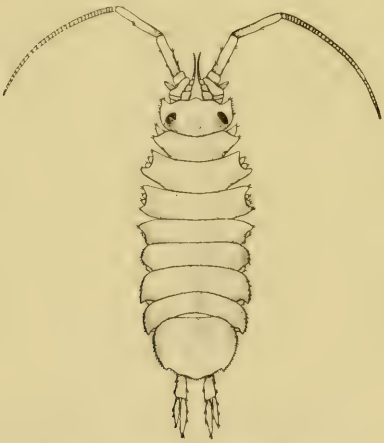

Figure 7. *Janira occidentalis* Walker.

Thoracic segments subequal in length. First segment of thorax has post-lateral angles rounded and prominent. Epimeral lobe occupies antero-lateral angles. Second and third segments have both antero- and post-lateral lobes with bilobate epimera between. Fourth segment has antero-lateral lobe prominent and rounded, post-lateral less prominent; single-lobed epimera between. Fifth similar to fourth with antero-lateral lobe much more rounded and conspicuous. Sixth and seventh have antero-lateral lobe very prominent and produced sharply at posterior extremity; post-lateral lobe obsolete, its place occupied by epimera. First pair of legs prehensile, remaining ambulatory

with bi-unguiculate dactyli. First leg has toothed propodus for half the proximal distance.

Abdomen composed of one large segment, possibly a very small anterior one though the suture was not distinct enough to make this certain. Telson is produced at post-lateral angles into a short, sharp point. Median part forms a rounded lobe. Uropoda composed of a peduncle about three times as long as inner ramus. Outer ramus slightly shorter than inner ramus.

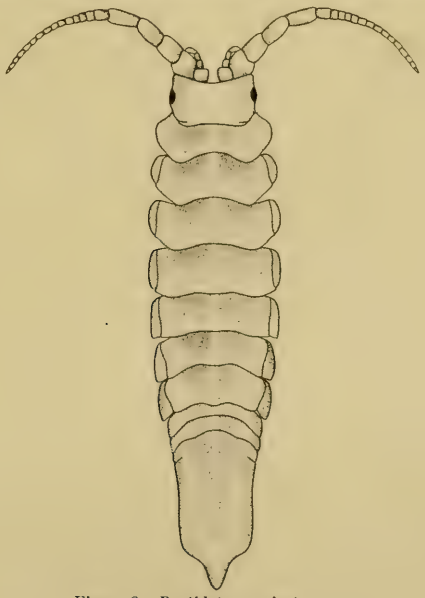

Figure 8. *Pentidotea aculeata* n. sp.

Pentidotea aculeata n. sp.

(Figs. 8, 9 and 10)

Locality—Low tide pools, Laguna Beach, California.

Color—Reddish brown in the male; female a more delicate pink with white spots along median line of back and two similar

rows of markings, each in a line half way between the median line and the lateral margin. Both male and female have all the segments and sutures outlined with a bright red line.

Body of male narrow and elongate and arched along median line. Length 23 mm., greatest width 6 mm., almost four times longer than wide.

Head about twice as wide as long, excavated on frontal margin with antero-lateral angles distinct but rounded. Posterior

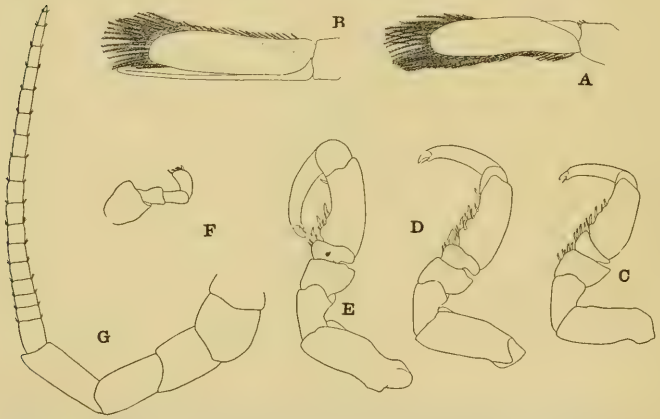

Figure 9. *Pentidotea aculeata* n. sp. A, first pleopod of male; B, second pleopod of male; C, first leg; D, second leg; E, seventh leg; F, first antenna; G, second antenna.

margin slightly concave with a short red mark extending horizontally from a post-lateral position. Eyes on lateral margin midway between anterior and posterior margins and almost round in shape. First antennæ possess four articles; first broad, almost as wide as long; following three articles not half as wide; second and third subequal; last clavate and slightly longer than the two preceding. First antennæ extend to end of second article of peduncle of second antennæ. Second antennæ have a peduncle of five articles: first short; second and third subequal, twice as

long as first; fourth not quite twice as long as third; fifth slightly longer than fourth; flagellum consists of seventeen or eighteen articles. Maxillipeds have a palp of five articles.

Sides of thorax almost parallel in male. All but first segment have epimera which extend to end of posterior margin. Epimera of second and third and fourth segments about equally wide from anterior to posterior margins. Fifth, sixth and seventh much narrower at anterior than at posterior margin. Legs alike in structure.

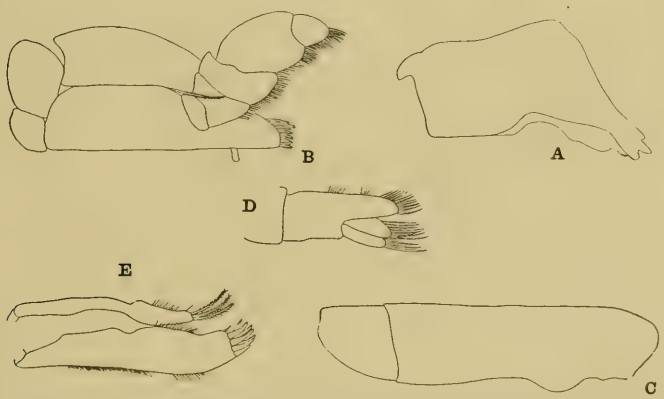

Figure 10. *Pentidotea aculeata* n. sp. A, mandible; B, maxilliped; C, opercular valve; D, second maxilla; E, first maxilla.

Abdomen 8 mm. long, 4 mm. wide at anterior end; composed of two short segments, a partially coalesced and a long terminal segment; the latter narrow and slightly excavate on the lateral margins, prolonged at median posterior extremity into a pronounced tooth, 1 mm. long. Post-lateral angles rounded. Opercular valves composed of a long anterior and a short posterior part. Carina not apparent on anterior portion.

The above description applies only to the male. Along with these a number of other specimens, all females, were collected which are slightly different in shape: have lateral margins less

parallel, more arched. They were lighter in color and more distinctly marked than the males. These differences are probably only sexual.

These specimens appear to lie close to *Pentidotea whitei* in many details, but in others are quite different. The male of *P. whitei* is described as being much larger—17 mm. by 34 mm.—and about three times as long as wide, whereas the male of these Laguna specimens is almost four times as long as wide. In *P. whitei* the epimeron of the second segment becomes narrower from the anterior to the posterior margin. Here the epimeral suture is practically vertical and the epimeron is about as wide anteriorly as posteriorly. The anterior margin of the head is more distinctly excavate and the antero-lateral angles more pronounced than in *P. whitei*. The eyes are about round, whereas in *P. whitei* they are twice as wide as long. The last abdominal segment is more elongate and the terminal process more pronounced than in *P. whitei*. It therefore seems evident that this isopod represents a new species.

The Nervous System of *Chelifer*

WILLIAM A. HILTON

There has been very little published on the nervous system and sense organs of arachnids and almost nothing on pseudoscorpions. There are, however, a large number of papers dealing with the classification of the latter and a few anatomical papers, such as those of Bertkau '87, Croneberg '88 and Supino '99. I have not seen these three works. There are no references given to them by the recent investigators of the arachnid nervous system.

Some of the early work dealing with the central nervous system of Arachnida we find recorded in the papers of Treviranus '16 and '32, Brandt '40, Grube '42. These authors describe and figure in a general way the external form of the nervous system of spiders. A more recent paper is that of Schimkewitch '84. This author considered the brain of Epeira and determined two regions in the supraesophageal ganglion, an optic region connected with the optic nerves, and a mandibular connected with nerves to the mandibles. Saint Remy '90 has an extensive contribution to the nervous system of spiders. He considers especially the brain in which he names the two chief regions, the ocular and the rostro-mandibular because the so-called mandibular nerve supplies the upper parts of the head as well as the cheliceræ. Many details of structure are given for the genera, *Lycosa, Thomisus, Epeira, Tegenaria, Drassus, Segestria, Pholcus* and *Eresus*. Something to correspond to mushroom bodies of insects is recognized in the posterior stratified body located in the uppermost part of the head in a lobe at the posterior dorsal region of the brain.

The paper of Lambert '09 is chiefly an embryological study of parts of the nervous system of *Epeira*. He figures the adult brain of *Argiope* with cheliceral and mandibular branches coming off from the subesophageal ganglion, or at least farther from the optic mass than they are usually described and figured. More recent papers on the nervous system of spiders are those

of Janeck '10, Hilton '12 and Haller '12. There is a more careful consideration of nerve tracts in the more recent papers. Haller recognizes anterior and posterior pedunculated bodies which may correspond with the striated body of Saint Remy.

One of the first papers dealing with scorpions was the one by Newport '43. In this the general form of the nervous system and its branches is considered. A little earlier than this, 1832, Treviranus gave a less perfect account of the nervous system of this form. Saint Remy '90 found a general agreement between the nervous systems of spiders and scorpions. Patten '90 published a paper including work on this group. In his book of 1912 there is also a considerable discussion of scorpions. The work of Haller '12 is an important one in this connection.

The literature on the nervous system of the other arachnid groups is very scanty. There is a paper of Borner '04 on the Pedipalpida. Allen '04 describes the nervous system of the cattle tick, as irregularly oval, pierced by the alimentary canal and penetrated by air tubes from opposite sides. The nerve trunks come off in pairs, five large and two small. Those who have studied phalangids are Treviranus '16, Tulk '43, Leydig '62, Saint Remy '90. Gaubert '93 describes ganglia in the feet of phalangids. Loman '05 describes the nervous system in phalangids. The usual nerves are described and a number of small lateral and intestinal ganglia are figured. The numerous papers on the nervous system of *Limulus* will not be mentioned at this time.

The species of *Chelifer* chiefly used in this investigation was *scabriculus,* although a few specimens of *fuscipes* were examined. The small size of the animals and the strong chitin do not make this group a favorable one for the detailed examination of the nervous system. However, the group in itself is interesting and the more general features of the nervous system and sense organs will be considered as completely as possible.

The pseudoscorpions resemble scorpions in many external features, but seem to be closely related to spiders. The study of the nervous system seems to show a closer relationship with the spiders. In Vol. I, p. 621 of Parker and Haswell's zoology

there is a statement to the effect that there is some indication of an abdominal ganglion back of the cephalo-thoracic mass in pseudoscorpions. I have made series of *Chelifer* as well as a large number of dissections and have found no indication of such a ganglion in any of the specimens.

Methods. Due to the very resistant chitin it was very difficult to make good serial sections. Fluids which softened the chitin to any degree, ruined the internal organs at the same time. A few perfect series were obtained through the bodies of some of the younger specimens, but with the older ones it was necessary to remove a large part of the chitin of the body-wall, or to remove the nervous system entirely.

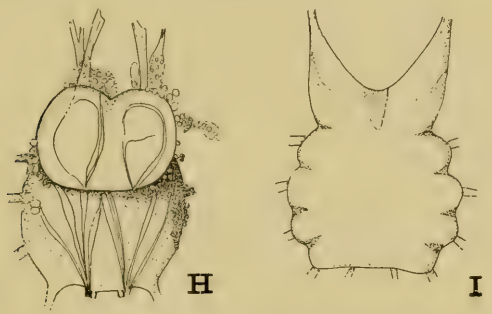

Figure 1. The central nervous system of *Chelifer*. H, the nervous system from above, showing some of the nerves, cells and groups of cells which may in part represent ganglia and some of the tracheal tubes in the nervous system. The brain is at the top of the figure. I, central nervous system of Chelifer shown in ventral view. The palpal nerves are those at the top of the figure. Compiled from several nervous systems. X50.

Most of the usual neuroglical methods were used, such as those of Golgi, Cajal and methylene blue, but with small success. The best preparations were obtained by fixing in Flemming's fluid and staining on the slide with methylene blue, neutral red or hematoxylin. For a clear idea of the form of the ganglion and nerves, dissections were made of fresh and preserved specimens. Usually the dorsal body-wall was removed in one piece and the

internal organs separated with needle points. The best results from this method were obtained from formalin fixation, for this reagent left the tissues more transparent and less fused with each other. The tracheæ within the nervous system were demonstrated by mounting the freshly removed nervous system to a glycerine solution. The air in the tubes made them clear and conspicuous structures.

General Form of the Ganglia. The central nervous system consists of a closely fused mass of supra- and sub-esophageal ganglia. From above, the "brain" forms a nearly spherical dorsal mass. Back of this and below the esophagus, but closely connected with the brain is the fused sub-esophageal and thoracic ganglia. This is not easily seen from above, but when removed from the body it is evident. The globular supra-esophageal ganglion or brain has two pairs of nerves closely associated with its cephalic end. The more dorsal of these is the ocular pair which comes to the brain from the simple eyes on the sides of the head. The more ventral is the mandibular, or rostro-mandibular.

The sub-esophageal ganglion has four pairs of nerves for the legs and a larger cephalic pair supplied to the pedipalps. This larger branch divides into two within the appendage and one of these parts soon divides again. This is similar to the branching shown by Newport in the pedipalps of the scorpion. Two small nerves extend from the caudal region of the ganglion towards the abdomen.

Tracheal Supply to the Nervous System. From the cephalic abdominal region two large tracheal tubes run forward a short distance and then break up into bundles of very small branches. Many of these fine tracheoles pass in masses forward to the thoracic and head region and into the central nervous system. Two chief bundles come to the ganglionic mass from caudal regions, the smaller more lateral bundle is more superficial, it divides into two smaller groups of tubules, a lateral and a median. Both of these send tracheoles to the brain and some small strands run beyond up into the upper regions of the head. The more ventral of the two chief bundles of tracheoles also divides

into two and these are distributed to the lateral medial portions of the sub-esophageal mass of the nervous system. The trachea within the nervous system are not as abundant as in insects. Long tracheoles pass through the brain and ganglion as straight or slightly curved lines. There is no branching or anastomosis.

Figure 2. Diagram of the tracheal supply to the central nervous system of *Chelifer scabisculus*. X50.

The paper by Allen '04 on the anatomy of one of the Acarina is the only one I have found referring to the tracheæ in the central nervous system of Arachnida.

Sense Organs and Peripheral Nerves. Scattered or grouped sensory hairs are found over the surfaces of the body, especially

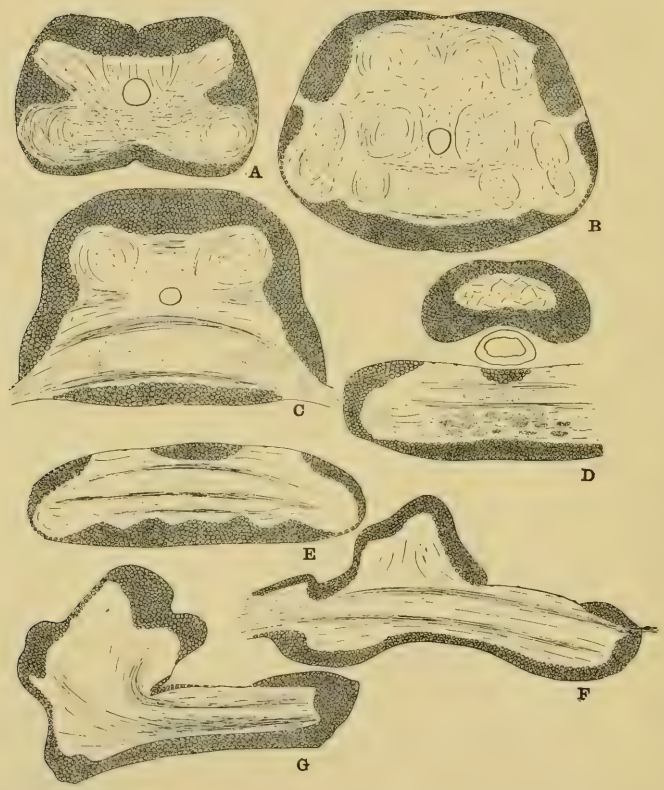

Figure 3. Drawings from sections through the central nervous system of *Chelifer*. All figures X200. A to E, cross sections through the nervous system of a single individual at various levels. The dorsal side is up. A, section through the cephalic end, esophagus in the center, general distribution of fibers and cells shown. B, a similar section farther down. C, section through leg nerves. D, section through the caudal end of the brain. E, section below the brain. F and G, sections cut longitudinally through the nervous system of a young *Chelifer fuscipes*. F, is nearer the middle line and through an abdominal nerve. The dorsal side is up in both and the head end to the left.

on the dorsum. The appendages are also clothed with similar small hollow hairs of the type found so generally among arthropods. These hairs are very small in many places but in certain regions as on the pedipalps they are very long and slender. The hairs are not only hollow but there is a passageway through the chitin below the seta, even in places where the body-wall is very thick. Some hairs are sunken at their bases and the whole neighborhood of the seta elevated into a little knob. Sensory cells of a bipolar type are found at the bases of the hairs in the more perfect sections, these send one process into the base of the hair. These cells were often easily distinguished from the surrounding hypodermal cells by their different shape and staining reactions although the cell process might not extend into the hair. It seems probable that all the hairs of the animal are sensory and probably tactile. Possibly the long hairs of the pedipalps are also tactile. There was no evidence of any other sense organ except the eyes. In addition to the usual type of hair just described a simple branched form was found.

There are two simple eyes, one on either side of the head near the base of the pedipalps. These eyes consist of a thin layer of clear chitin on the outside and a small group of sensory cells below this. On the surface of the cornea of chitin a number of regular knobs of small size take certain stains such as methylene blue.

Peripheral nerves, such as those supplied to muscles were found especially in longitudinal sections of appendages. These strands were found to be very delicate and deeply staining nuclei were found along the course of the fibers.

Peripheral Ganglia and Plexuses. No very definite peripheral centers were found in *Chelifer,* but in certain dissected specimens in the head and thoracic region there are individual cells and small groups which undoubtedly serve as peripheral ganglia. Some of these seem to be quite intimately connected with the more cephalic nerves and the central nervous system. Some of these seem to be true nervous elements although all may not be. Most of the cells and groups of cells are clustered about the cephalic portion of the nervous system. The numerous

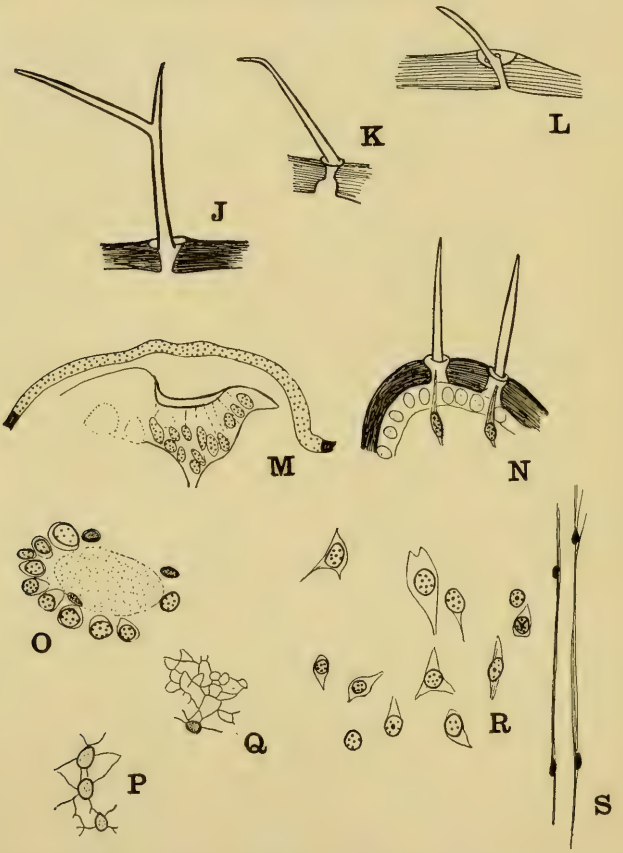

Figure 4. Details of structure of *Chelifer*. All figures X700. J. K. L, types of hairs shown in section. N, hairs supplied with nerve cells and fibers, from *Chelifer fuscipes*. M, Section through an eye, nearly all of the sensory cells are shown in this section, the clear chitin above the sensory cells appears covered with small bodies which stain. These are shown as dots in the drawing. O, section across the rostro-mandibular nerve trunk showing nerve cells at the surface. P, neuroglia cells from the center of a cell area, the nerve cells lie between the strands. Q, neuroglia cell with a part of the network of fibers which forms a support for the nerve fibers in the center of the ganglion. R, nerve cells from the central nervous system. S, nerve strands from the peripheral nervous system.

ganglia of *Phalangium* as described by Loman '05 seem to resemble the peripheral masses of *Chelifer* although they seem to be more caudal in position.

In addition to these cells and irregular masses about the central system there are a number totally or partially surrounding the mandibular nerve some distance from the brain.

There are scattered cells, apparently nerve cells, under the hypodermis and some of these may be similar to the peripheral plexus described in insects. Methylene blue used repeatedly failed to demonstrate such a plexus however.

Nerve Cells of the Central Nervous System. The nerve cells are rather small, closely crowded together with large nuclei and very little cytoplasm. The cells vary little in size and present a uniform appearance in all parts of the central ganglia. Some of the cells have two or more processes, but most cells are unipolar with the process directed out to the central mass of fibers. Cells in small groups may in places send their fibers in together, forming a distinct bundle. No demonstration of special granules of tigroid substance was made although the usual methods for its demonstration were used, but the large nuclei nearly always showed six or eight distinct masses of chromatin. Sometimes there was an indication of a larger body which may have been a nucleolus. In some cells instead of rounded masses of chromatin there were longer rod-like masses.

The neuroglia cells were easily demonstrated. They had rather large nuclei and very little cytoplasm forming a meshwork of strands. In the meshes of this network the nerve cells are arranged, much as Haller '12 has described and figured for spiders. A delicate membrane of thin cells with prominent nuclei surrounds the nervous system as shown in Haller's figures.

Cell Areas. In the brain the nerve cells cover the central fibrous mass on all sides. The cells are most numerous at the cephalic and caudal ends and also laterally. In the mid-dorsal region they are least abundant, forming in places hardly a double row. The more cephalic ventral portions of the supra-esophageal ganglion are indistinguishably fused with the subesopha-

geal. The prominent cephalic and caudal masses of cells seem from the position of the nerve trunks and the arrangement of the fibers to be largely associated with the optic and mandibulo-rostral nerves respectively.

The subesophageal ganglion is rather uniformly covered with rather thick masses of cells ventrally, there is but little indication of more marked masses where the leg nerves are given off. The lateral parts of the ganglion are also covered with nerve cells and these reach up dorsally except where nerve trunks arise. On the dorsal side there are few nerve cell groups towards the middle line except at the cephalic and caudal ends.

Distribution of Fiber Tracts. In the brain there are few large commissures, one large band is sometimes made out ventrally, but there are many cross fibers not definitely located in distinct bundles.

In the subesophageal ganglion there are two main commissures usually evident connecting lateral parts. The more dorsal of these is especially marked in the cephalic regions of the ganglion and in places appears as an arched band just dorsal to the central region. Towards the lower end of the ganglion the more ventral commissure often appears divided.

Fibers from the brain run in long and shorter tracts and connect the brain with lower levels. Some of these fibers run into the long dorsal and ventral tracts which run the length of the ganglion similar to those described and figured by Haller '12. The dorsal tract probably connects wider areas; it seems to have a large part of the fibers of the abdominal nerves. Fibers from and to the brain connect the dorsal tract to posterior regions, and ventral tracts are broadly connected with the anterior region of the brain. Short connectives are found in all parts, cells in each region do not send their fibers straight in to the central part of the ganglion in every case, but may act as connecting cells for neighboring parts. The brain is closely connected to the rest of the central nervous system and short connections are found as well as the longer ones mentioned. In the lower regions there are many connections from one area to the next.

Haller '12, homologizes areas in the spider and scorpion brain to the mushroom bodies of other arthropods. These areas are located in the dorso-lateral portions of the nervous system in cephalic and caudal regions. These areas are marked by clusters of small nerve cells and small clear areas in this region. In *Chelifer* all the cells are about the same size; there are, however, little clear areas in the same general regions of pseudoscorpions. There are two areas on each side of the brain dorsally just in front of the great caudal dorsal mass of cells and just back of the cephalic dorsal mass. These little areas are almost free from cells and they seem to be the only indications of anything like mushroom bodies.

In some specimens the fibers are intensely stained and at certain areas such as the region just under the large cephalic mass of cells on either side of the brain, fibers extend down from the cell areas of the brain. It is possible that some of these fibers represent connections which correspond to the mushroom fibers.

IMPORTANT CONCLUSIONS

1. There are no important abdominal ganglia beyond the fused mass of the central nervous system.
2. The pedipalpal nerves are the largest.
3. A small number of simple more or less straight tracheoles penetrate the nervous system.
4. There are few deep-staining masses of fibers.
5. The cells have very little cytoplasm. The nuclei are usually provided with six or more chromatin granules.
6. The sense organs so far as determined are: a pair of simple eyes and hollow setæ provided with nerves from bipolar nerve cells.
7. The cells of the brain are largely unipolar, but other forms are found.
8. The neuroglia cells form a network of their fibers and this network between nerve cells serves as a sort of sheath for them. The fibrous part of the nervous system also has strands from neuroglia cells and this forms a support for the nerve fibers which run in various parts of the ganglia.

9. There are very slight indications of mushroom bodies.

10. Apparently the two great masses of cells in the brain are associated with the mandibulo-rostral and optic nerves.

11. The peripheral ganglia are represented by irregular masses of cells.

12. Besides numerous short connections there are large tracts running from the brain to other levels, and a dorsal and ventral longitudinal tract in the subesophageal ganglion.

13. There are two to three well marked commissures in the ventral mass of the nervous system.

14. The brain is closely fused with the ventral mass of the ganglion.

15. There are no abdominal ganglia. In general the nervous system is more like that of a spider than of a scorpion.

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(Contribution from the Zoological Laboratory of Pomona College.)

A New Species of Collembola From Laguna Beach

GERTRUDE BACON

In Vol. IV, No. 3, of the Journal of Entomology, I described some Collembola found at Laguna Beach of the genus *Isotoma*. During the same summer, under the same conditions and environment, I found a great number of specimens of the genus *Entomobrya,* which, due to the kindness of Professor L. W. Folsom, were identified as belonging to a new species. These were found on the under side of large rocks as far out in the water as it was possible to turn over the stones. This is the first time that this genus has been reported found under rocks in salt water. This species occurred very abundantly, far more so than any of the others, and was collected in great numbers. This paper is a study of the characteristics of this species.

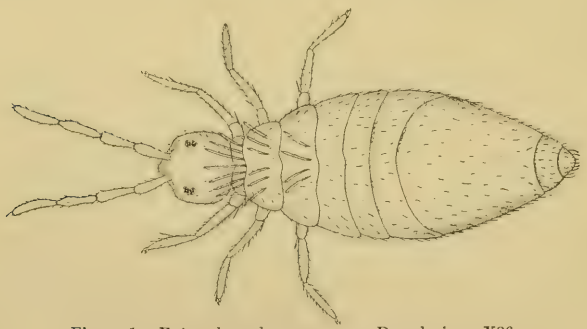


Figure 1. *Entomobrya laguna* n. sp. Dorsal view. X36.

Entomobrya laguna n. sp.

(Figs. 1, 2 and 3)

Length 2 mm. *Color*—Dark brown mottlings with yellow ground color except on the ventral side of body, furcula, thorax

I, and the beginning of each segment, which are yellow; antennæ and legs dark blue. There is not a great range in the color variation, although in some specimens the yellow predominates, in others the brown mottlings. Body sub-cylindrical, widest at segment VI; covered with fine hairs with many large geniculate ones on the anterior part of the body and short clubbed ones on the last segment of the abdomen. For the sake of clearness only a few hairs are shown in Figures 1 and 2. Head held horizontal, sub-cylindrical in shape. Antennæ (Fig. 3, A) about three times as long as head; four segments subequal in length; IV longest; I shortest; II and III subequal. Ocelli (Fig. 3, B) sixteen, eight in each eye spot, six large and two

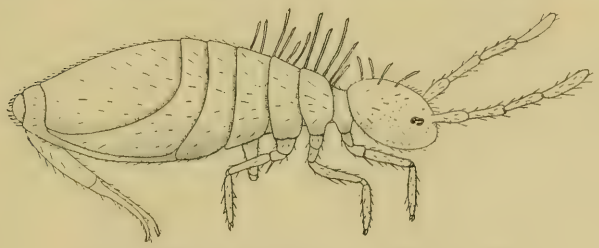


Figure 2. *Entomobrya laguna* n. sp. Side view. X36.

smaller ones. There was a great deal of variation found in the size and arrangement of the ocelli, in some the smaller eye spots were very minute while in others they were nearly the same size as the other six. Thorax—I visible, II largest. Legs long, slender; long femur and tibia, small tarsus with two claws (Fig. 3, C, D, E). Both are wide at the base and then become narrow and pointed; superior armed with two teeth opposite each other and at the end of the dilated portion; inferior armed on the outer side about midway with a very minute tooth not visible on some of the claws. The claws on the three pairs of legs differ somewhat. On the first the claws are about equal in length and both about equal in width at the base; the inferior slopes abruptly into a point. On the second pair of legs the superior is the

longest, the base of the inferior is not rounded but changes to the slender part abruptly, making an angle. In the last pair of legs the claws are farther apart, equal in length; the inferior is more curved than on any of the others. Abdomen—The seg-

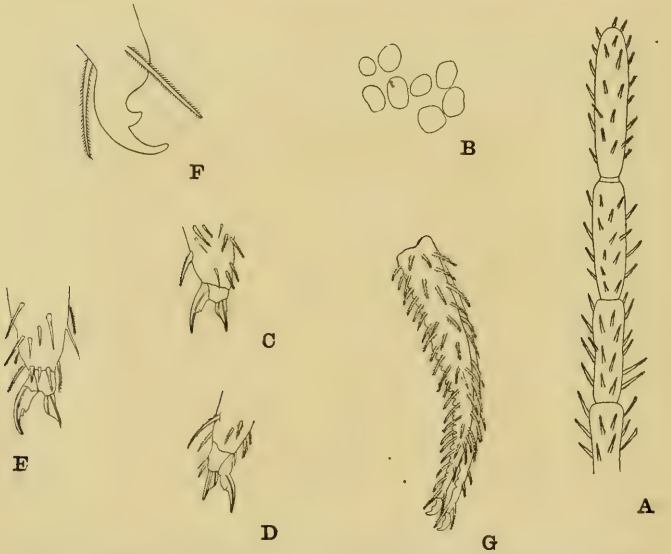


Figure 3. *Entomobrya laguna* n. sp. A, antenna; B, eyes of one side; C, claws; D, claws of scond pair of legs; E, claws of third pair of legs; F, mucrones; G, dentes with mucrones. A, X90; B, X252; C, D, E, X216; F, X472.

ments are unequal, IV more than four times III; ventral tube well developed. Furcula—(Fig. 3, G) Dentes and mucrones a little longer than manubrium; dentes serrated and densely covered with plumed hairs. Mucrones—(Fig. 3, F) Two teeth, no basal spine.

(Contribution from the Zoological Laboratory of Pomona College.)

Shorter Articles and Reviews of Recent Important Literature

SEVENTH KERMES (*COCCIDÆ*) FROM CALIFORNIA

GEO. B. KING
Lawrence, Mass.

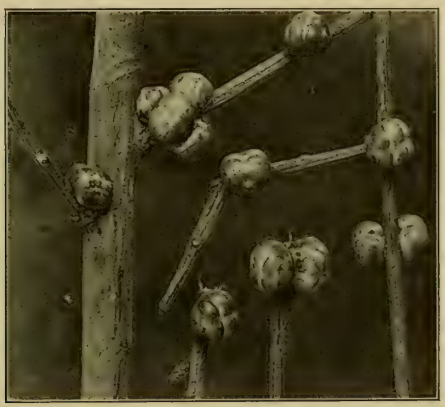


Figure 1. *Kermes essigii* King on twigs of the California Coast live oak, *Quescus agrifolia* Neé. Twice natural size. (Photo by E. O. Essig).

Kermes essigii n. sp.

Female scale—Light brown, 6 mm. long, 6 mm. broad and 5 mm. high; surface shiny. Under normal conditions practically globular, of two distinct forms, one with a deep broad longitudinal constriction, with sides bulging, and four transverse bands of a light cream color. The constriction is not pallid, but of the same color as that of the scale, light brown. The entire surface is peppered with minute black specks, only visible through a hand lens of 20 diam.; there are also several large black dots about the size of a pin head viewed under a hand lens. The other form is of the same

color and markings, but distinctly gibbose. Treated with KOH the scale turns black, and after prolonged boiling it turns liquid black. Derm after boiling, by transmitted light, yellowish, no structural characters visible.

Larvæ—Dark red-brown (lost in boiling in KOH), elongate-oval.

This is a very pretty species. Its nearest ally is *K. galliformis,* from which it is separable by having a longitudinal constriction which is not pallid, and by being gibbose. It is also allied to *K. cockerelli* and *K. gillettei* in being gibbose. It was first collected by Mr. E. O. Essig in the Santa Paula Canyon in the mountains near Santa Paula, Ventura County, California, in 1910. In August, 1913, Mr. S. A. Pease collected it in San Bernardino County. Through Mr. Essig and Prof. Cockerell this material was turned over to me. The species was described from the large number of females in these sendings.

The host plant is the California coast live oak, *Quercus agrifolia.*

I am pleased to name it after its first collector.

THE EIGHTH CALIFORNIA KERMES

Kermes occidentalis n. sp.

GEO. B. KING
Lawrence, Mass.

Female Scale—Globular in outline; 5 mm. in diameter; of a dull gray color. Segmentation indicated by five transverse narrow blackish bands, which are broken at intervals by somewhat larger round black dots. Surface between the bands of a marbled light gray-brown. The entire surface is dull, not shiny, and is covered with very minute black specks seen only under a hand lens.

The above species was received from Mr. E. M. Ehrhorn in 1901 taken on *Quercus* sp. in California and labeled *Kermes galliformis* Riley. The latter species is very different, the color being pale yellow; appears minutely and evenly speckled with brown under a hand lens and is more or less confused or mottled with gray or brown.

Just recently Mr. E. O. Essig sent me *Kermes galliformis* Riley and *Kermes cockerelli* Ehrh. collected by Mr. E. J. Branigan on Cache Creek near Yolo, Yolo County, California, May 16, 1910, on California black oak, *Quercus kelloggii* Newb. Here they were associated together on the same host plant. *Kermes cockerelli* Ehrh. is of a light brown color and strongly gibbose.

In some of the markings *Kermes occidentalis* is nearest allied to *Kermes arizonensis* King, found in Arizona.

Figure 1. a, *Kermes occidentalis* n. sp.; b, *Kermes cockerelli* Ehrh.; c, *Kermes galliformis* Riley. (Photo by E. O. Essig).

A COCCID FOUND ON THE SYCAMORE

H. J. RYAN

A number of the genus *Pseudococcus* were found under the bark of a sycamore within the limits of Claremont, California. Only one tree was found to have these insects on it although there were several in the cluster. The insects were associated with ants which seemed to be guarding them. In general appearance the species appears like *P. citri*, differing, however, in having less prominent lateral appendages, callouses on the lateral margins of the segment bearing two short spines, and with circumanal spines of the same length as those of the anal lobes. As nearly as has been determined by comparison with the descriptions given for *P. quercus*, the specimens

resemble this species. The host plant of *P. quercus* is given as the canyon live oak, *Quercus chrysolepis,* and if these are of this species then it is worthy of note that *Platanus racemosa* as well as *Quercus chrysolepis,* is a host.

MOSQUITOS AND COBWEBS

James Zetek, Ancon, C. Z.

During February and March, 1913, extensive breeding in a salt-water marsh along the old French canal caused a heavy influx of adults of *Anopheles tarsimaculata* Goeldi and *Aedes taemiorhynchus* Wiede., at Gatun, Canal Zone, about 4,000 feet distant. A cement shed and a store house, only 600 feet to the south-west from the breeding place contained many cobwebs, and these were so weighted down with mosquitos of the species mentioned, that in several cases the webs showed breaks. It is no exaggeration to say the cobwebs were black with these mosquitos.

Another instance of mosquitos in cobwebs was seen June, 1913, in native shacks near Culebra, C. Z. In these there were on an average of six mosquitos to a web, principally *Culex quinquefasciatus* Say and *Aedes calopus* Meigen. Two specimens of *Mansonia titillans* Walker, three of *Aedeomyia squamipennis* Arib. and three of *Lutzia bigotii* Bellardi were also noted in these webs.

The last instance was noted in October, 1913, at Paraiso, C. Z., while with Doctor Martini and Mr. Pickett. In a single shack, adults of *Culex quinquefasciatus* Say were present in cobwebs. It did not appear that the spiders cared much for such food, probably because larger diptera were plentiful and to be had easily. It seems mosquitos are accidentally entrapped in these webs while seeking shelter in corners of buildings.

PRELIMINARY REPORT ON THE PARASITES OF COCCUS *HESPERIDUM*

P. H. Timberlake

Jour. Economic Entomology, Vol.VI, No 3, 1913

In this paper a short sketch of *Coccus hesperidum* itself is given and then a very careful description of the five parasites and eight hyperparasites of the scale. The author closes with a paragraph on the source of the soft scale in California and a paragraph on the predaceous enemies of the scale.

George Ash.

The first of a series of pamphlets on the "Control of the Orange Maggot (*Trypeta ludens*)" has been published by D. L. Crawford for the Mexico Gulf Coast Citrus Association. Mr. Crawford studied this pest while he was in Mexico in the summer of 1910. Because of his knowledge of the subject, this association called him to Mexico last summer to lay out directions for fighting the Orange Maggot.

The circular states that the Orange Maggot is distributed over a large portion of Mexico. It attacks several fruits other than citrus fruits and this makes it more difficult to control. In order that the members of the association may work intelligently on the fly, a brief life history is given. Mr. Crawford gives two sets of directions for the control work. One method is to pick up the fruit as fast as it falls and to destroy it while the maggot is still working inside. The other method is to spray the trees with a poisoned, sweetened liquid in the period when the flies appear. The flies eat this poisoned bait and are killed.

E. T. McFadden.

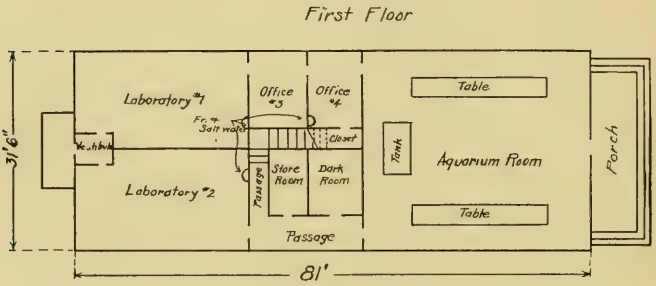
Laguna Marine Laboratory and Tank House.

The Laguna Marine Laboratory

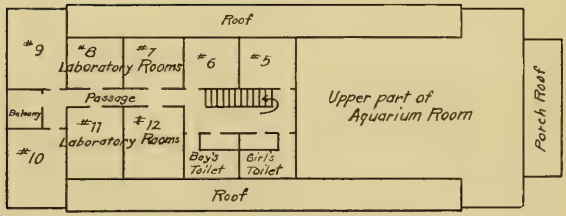
One of the most interesting and beautiful parts of the Southern California coast is found at Laguna Beach. The rugged cliffs, the level stretches of shore, the high hills and above all the great abundance and variety of plant and animal life make it

The channels just north of Laguna. These channels are very deep and contain a magnificent display of kelps (*Eisenia* and *Egregia*). This whole area is exceedingly rich in life. From first Laguna report.

an ideal situation for a Biological laboratory. The summers are cool and the winters are warm so that work may be done here at any time of the year. Pomona College has conducted summer school work at Laguna for the past three years and two buildings were erected for this purpose in the spring of 1913. The chief



LAGUNA BEACH MARINE LABORATORY



Second Floor

structure has a large aquarium room in front and two class laboratories back of this, all provided with running water. In addition to this on the first floor there are store rooms, a dark room and private laboratories. Up stairs there are eight more private rooms for special investigators. A tank house near the larger building furnishes salt water for the aquaria and salt

Cypselurus californicus. From Metz, first Laguna report.

water taps. There is considerable additional room in this building.

The laboratory will be used largely for teaching in the summer but there will be opportunity for special investigators to work at any time of year and for any period. It is the hope that this station may be useful to any qualified botanist or zoologist who

Showing one of numerous small bays with sand beaches. At low tide, between the rocks in foreground and the point at left, a large bed of Phyllospadix is accessible. From first Laguna report.

Showing region just north of pier at low tide. A large area of rich tide pools are very accessible here. From first Laguna report.

may wish to study for a time in this part of the country. The summer course aside from the work of special investigations will be given as a part of the work of Pomona College summer school, although of course it will be open to any others who may be prepared.

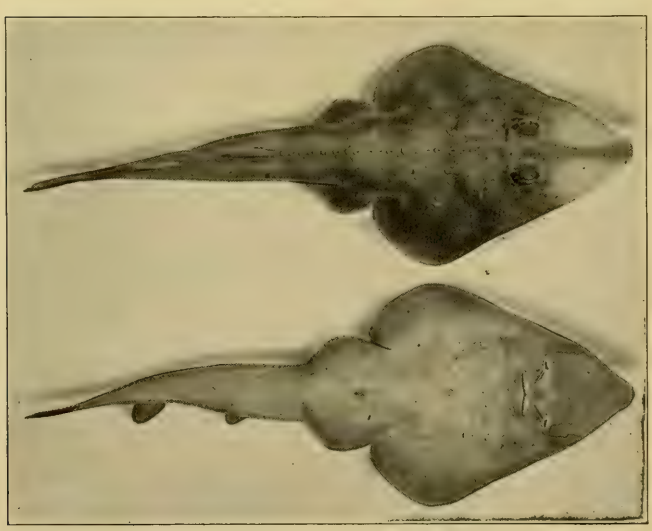
The laboratory buildings are situated at the foot of the cliffs a short distance back from the ocean and a convenient distance from one of the best collecting grounds. Great masses of sea

Showing the tide pools at Mussel Point. Here are immense colonies of mussels, barnacles, sea urchins and coralline algæ. This place is exceedingly rich collecting ground. From the first Laguna report.

weed grow on the nearby rocks, while out a short distance great kelp beds furnish hiding places for many forms of animal life. The irregular rocks and points, the inshore pools and channels at low tide are alive with a great variety of plant and animal forms.

Some of the many interesting types which have been found along the shore might be mentioned to give a little idea of the

Clinocottus analis. From first Laguna report, after Metz.

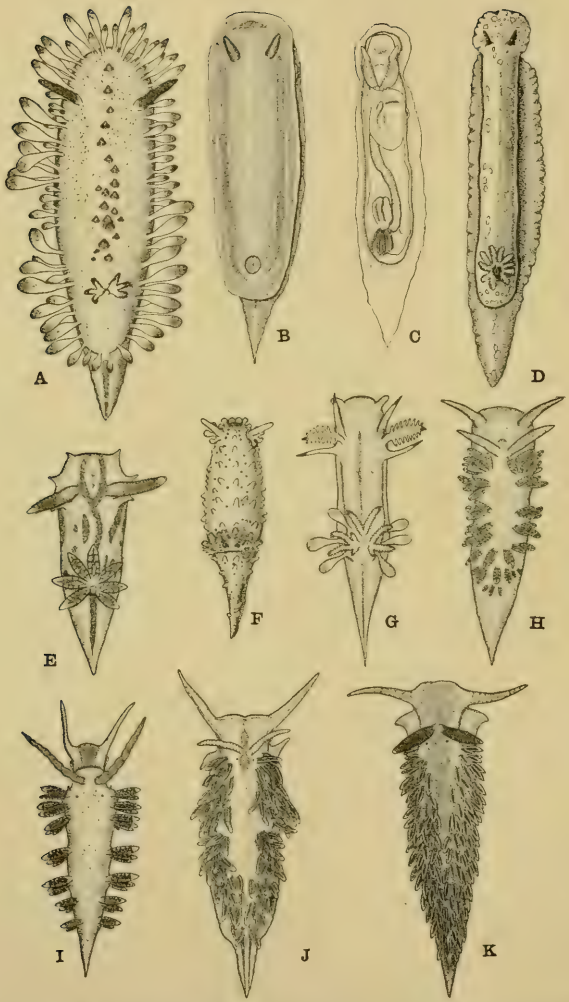


Young *Rhinobatus productus.* From Metz, first Laguna report.

variety and abundance of life. There are the sea weeds, brown, green and red, of many kinds and in great abundance over the rocks near shore as well as farther out. Nearly a hundred species of these have been identified so far. Sponges both simple and complex are found in the kelp. Sea anemones are abundant over rocks and in the tide pools near shore. In the sand and under rocks are many kinds of segmented worms, while flat worms and round worms are also abundant in various places.

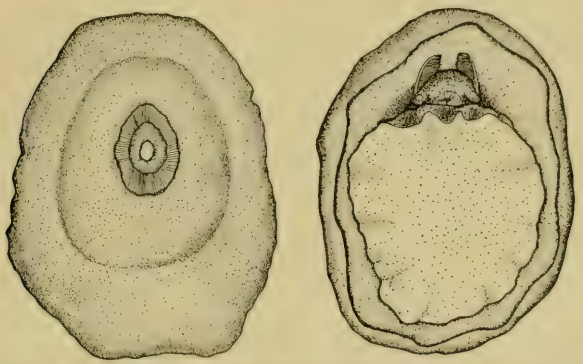
Polypus bimaculatus. From Berry, first Laguna report.

There are three kinds of starfish, three species of sea urchins, several sorts of brittle stars and two species of holothurians, all of which may be obtained at low tide. Of the snail-like animals a large number have been found, many of the smaller ones have very beautiful markings and shades of color; there seems to be a variation in the occurrence of these from year to year. Among the larger molluscs are the key-hole limpet, abalone and the sea hare. Over fifty species of shells were collected one summer



Some of the nudibranch molluscs found at Laguna. A, *Laila cockerelli;* B, *Chromodoris porterae;* C, *Chromodoris* sp. (mantel removed); D, *Chromodoris* sp.; E, Genus?; F, *Aegires albopunctatus;* G, *Ancula pacifica;* H, *Cuthonia* sp.; I, *Hervia* sp.; J, *Hermissenda opalescens;* K, *spurilla* sp. From Guernsey, first Laguna report.

within a limited range. The octopus *Polypus bimaculatus* is abundant along the rocky shore and may be obtained at low tide. The sand, the rocks and the sea weeds are alive in many places with crustacea of many sorts, crabs and sand fleas of many species are abundant. There are several species of barnacles, and many very small crustaceans may be seen in the tide pools. Fish are abundant at Laguna and near by. Several species of sharks are found off shore, the shovel nose *Rhinobatus productus* among them. The moray *Gymnothorax mordax* is found

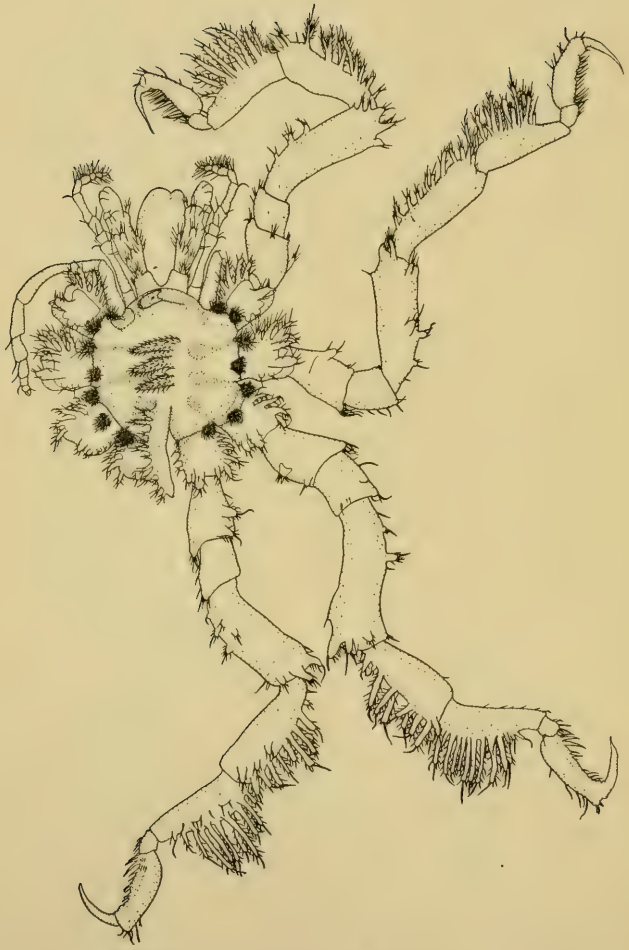


Lucapina crenulata. Dorsal and ventral views. From Guernsey, first Laguna report.

under rocks near shore at low tide. The flying fish *Cypselurus californicus* occurs off the coast and many other fish are abundant out a short distance about the kelp beds. A great variety and abundance of forms may be seen in the numerous tide pools, including one very interesting blind species.

In addition to the wealth of the sea, the hills and canyons furnish collecting places for many land forms and it is expected that the land and fresh water species will also be studied.

Laguna may be reached by auto stage from Irvine or Santa Ana. Stages run twice a day each way in the summer and once in the winter.



Ammothella spinosissima, much enlarged. A Laguna pycnogonid. Hall, first Laguna report.

Students may be admitted to courses in the summer school at Laguna who have entered college or who have finished their high school course. For those who register for regular courses the work will begin the last of June and continue six weeks. The following zoological courses will be offered; others may be announced later:

1. General Biology, with special reference to marine conditions. Lectures, recitations, field and laboratory work. For those who have had no biological work.

2. General Zoology. Lectures, laboratory and field work. A study of all the great groups of animals, their structures and relationships. Open to those who have had a course in biology.

3. General Entomology. Lectures, recitations, laboratory and field work. A study of the important orders and families of insects. Open to any who have had a course in general biology or zoology.

In addition to these courses general histology and microscopic technique and general embryology may be given to a limited number.

For further information address: Department of Zoology, Pomona College, Claremont, California, U. S. A.

News Notes

FORDYCE GRINNELL, JR.

"But, of still greater moment, is a letter in which Wallace tells Bates that he begins 'to feel dissatisfied with a mere local collection. I should like to take some one family to study thoroughly, principally with a view to the theory of the origin of species.' The two friends had often discussed schemes for going abroad to explore some virgin region, nor could their scanty means prevent the fulfilment of a scheme which has enriched both science and the literature of travel. The choice of country to explore was settled by Wallace's perusal of a little book entitled *A Voyage up the River Amazons, including a residence in Para*, by W. H. Edwards, an American tourist, published in Murray's 'Family Library,' in 1847. In the autumn of that year Wallace proposed a joint expedition to the river Amazons for the purpose of exploring the natural history of its banks."

—*Clodd, Pioneers of Evolution.*

"That which is in the man is greater than all that he can do." —*Jordan.*

Alfred Russel Wallace, the eminent naturalist, died in London, England, Nov. 7, aged 91 years. He visited California in 1887, on a lecturing and sightseeing tour.

Dr. Edwin C. Van Dyke, president of the Pacific Coast Entomological Society, has become a member of the Department of Entomology of the University of California.

Mr. H. H. Newcomb talked before the boys of the Lorquin Natural History Club in Los Angeles, on November 7, on some of his collecting trips in the eastern states.

The Rivers' Natural History Club, for boys, has been organized in Los Angeles, named after the oldest living naturalist of California, J. J. Rivers, who is 88 years of age.

Mr. E. J. Newcomer, well known as a collector and student of Lepidoptera, has been contributing a series of articles to the

California Cultivator on his observations of agricultural conditions in southern Europe.

Prof. Ralph Benton, of the University of Southern California, addressed the Biological Section of the Southern California Academy of Sciences, in October, on Bees; and on November 11 the Section was addressed by Dr. S. S. Berry on his work with the Cephalopods, and Mr. Harry S. Swarth spoke on "The Birds of Southern California."

Wants and Exchanges

Subscribers and others are urged to use these columns to make their wants known. As the Journal goes to all parts of the world we hope to make this a very useful feature of the publication. Exchange notes are free to subscribers.

WANTED—Myriopods from all parts of the world. Will name, exchange or purchase. R. V. Chamberlin, Mu. Comp. Zoology, Harvard Univ., Cambridge, Mass.

Will exchange insects of any order from Southern California, for Microlepidoptera from any part of North America, preferably pinned, with complete data concerning capture. Fordyce Grinnell, Jr., Pasadena, Cal.

HEMIPTERA—California Homoptera and Heteroptera, including all families, exchanged for specimens from all parts of the globe, but especially from North America.—E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

WANTED—Cephalopods (in alcohol); Chitons (in alcohol or dry); shells of West American Mollusca; zoological literature. Offered: West American and other molluscan shells; zoological pamphlets, mainly on the Mollusca. S. S. Berry, 502 Cajon St., Redlands, California.

California Syrphidæ, Aphididæ to exchange for non-California Syrphidæ. W. M. Davidson, Walnut Creek, Cal.

WANTED—For exchange, papers on marine and fresh-water Protozoa. Albert L. Barrows, Department of Zoology, University of California, Berkeley, Cal.

WANTED—Information on any mite-papers for sale or exchange that have an economic bearing. H. V. M. Hall, Room 8, Court House, San Diego, Cal.

WANTED—Specimens and separates relating to the pseudoscorpions, in exchange for local species. M. Moles, Claremont, Cal.

WANTED—Literature and determined specimens of Collembola, in exchange for local forms and literature. G. Bacon, Claremont, Cal.

WANTED—Determined specimens of Thysanura in exchange for local species. R. Gardner, Claremont, Cal.

WANTED—Separates relating to the nervous system and sense organs of the invertebrates in exchange for reprints by a number of authors on this and other topics relating to the anatomy of invertebrate animals. W. A. Hilton, Claremont, Cal.

THE BUTTERFLY FARMER

A monthly magazine for amateur entomologists. A comprehensive correspondence course in entomology, conducted under the auspices of The Agassiz Association, will be a leading feature during the present year. Subscription $5.00 per annum, single copies 50 cents. Names of dealers and purchasers and wants of subscribers advertised without charge.

Ximena McGlashan, publisher and proprietor, Truckee, Cal.

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